Journal of the Society of Arts.

FRIDAY, JANUARY 19, 1854.

ARTIZANS' VISITS TO PARIS.

The Committee met on Saturday, the 6th instant, T. Winkworth, Esq., in the chair. The Committee has learnt that cheap trips, on an extensive scale, to and from Paris, during the period of the ensuing Exhibition, at low fares, have already been organized.

The Committee is actively engaged in promoting the completion of arrangements for boarding and lodging the excursionists in Paris during their stay there, with interpreter guides, &c., on reasonable terms. As soon as the Committee is in possession of the actual terms on which the service will be performed, no time will be lost in making them known to the Institutions, with full information as to the means and expense by and at which individuals may avail themselves of the advantages offered.

INTERNATIONAL COMMERCIAL LAW.

A requisition having been made to the Council by several members of the Society, to the effect that it is necessary that another step should be taken by the Society to give practical vitality to the recent resolutions of the Council upon the improvement of International Commercial Law, the Council has appointed the evening of Friday, the 2nd of February, for the purpose of taking into consideration this important subject. At this meeting a short paper will be read, as introductory to a discussion.

The Council cordially concurs in the opinion expressed by one of the requisitionists, "that our Society, whose object is the Encouragement of Arts, Manufactures, and Commerce, ought to be at the head of this movement; for what would so certainly encourage, and tend to extend the arts, manufactures, and trade of all countries, one with the other, as a Code of Commercial Law by which the rights of traders as partners, as debtors, and as creditors—as shipowners—as insurers—as shareholders in national enterprises—as well as the rights of authors and artists, should be alike, and governed by the same forms of procedure in all."

The Council has received replies from the Chambers of Commerce in Belfast, Bradford, Bristol, Hanley, Liverpool, and Newcastle, approving of the suggestion that a congress should be held in Paris during the occurrence of the Universal Exposition this year; and the latter body remarks, that they conceive that it is one of the best means of bringing this question to a favourable issue. The replies from the Blackburn Chamber of Commerce and the Manchester Commercial Association do not express a distinct opinion, either for or against the proposed congress.

The following practical illustrations explain the objects contemplated by the proposed European Congress in Paris for the promotion of International Commercial Law:—

A most excellent opportunity presents itself in the forthcoming "Exposition Universelle" in Paris, in 1855, for advancing the assimilation of the Mercantile Laws of Nations. The Edinburgh Society for the Promotion of an International Commercial Code, presided over by Professor More, have transmitted an address on the subject to his Majesty the Emperor of the French, and by his instructions the same has been remitted to the Legislative Section of the Council of State, to report thereon to the Emperor.

During the preliminary arrangements for the holding of the Conference in London in 1852 on the assimilation of the commercial laws of England, Ireland, and Scotland, we had seriously in view the great importance of promoting a Commercial Code for the British empire, including the Colonies and Dependencies; and also that it should be so framed, stripped of all useless technicality, that, like the Justinean Code, it might be adopted by almost every other nation. Nevertheless, much difficulty was apprehended in the attempt to assimilate the mercantile laws beyond the three United Kingdoms. As to the Colonies, it was found that many of them are still governed by foreign laws—such as Canada and the Mauritius, by the French law; British Guiana, the Cape of Good Hope, and Ceylon, by the Roman Dutch Law; Trinidad by the Spanish law, &c. And as to foreign countries it was deemed desirable to endeavour, in the first instance, to assimilate the laws at home; and, in doing so, to examine, in a candid spirit, the institutions of foreign states, with a view to the introduction into this country of any principle which might be considered beneficial. The issuing of a Royal Commission for such an object has so far crowned our labours with success; nor can we omit to notice, as the fruit of the Conference of 1852, the several bills introduced into parliament, some of which have already become statutes, for the assimilation of the law and procedure between England and Scotland.

It is, however, important to expand our views on the subject. The increased means of communication, and above all a greater concurrence by France and other states in the principles of Free Trade, have caused a considerable extension of commercial intercourse between all civilized countries. The industries and resources of all countries are now open to the competition of the whole world; capital circulates freely, and is invested in mining and other enterprises of all descriptions. It is but natural to suppose that in proportion as these international transactions extend, so the sources of disputes between individuals of different countries may become more frequent. *The bankruptcy of a merchant in one country may affect a large number of creditors in other states;* suits for the non-delivery of produce or claims for inferior qualities, will necessarily be more numerous. *Bills of exchange* have a wider circulation. Such, in fact, is the connection between all mercantile affairs, and the essentially international character of commerce, that these relations mingle themselves in a thousand ways, and often affect individuals in modes as distant as they are unforeseen. It is the business of mercantile law to *establish rules for the settlement of commercial disputes, and to afford remedies for the enforcement of rights.* That it may do so successfully between merchants of different states, it is necessary that it should act similarly in all countries; that the geographical boundaries of a state shall not interfere with the purposes of commercial justice, and that a full knowledge of the re-

quisites of the mercantile law of nations may enable the merchants, the shipowners, and even the captains of merchant vessels to appreciate the nature of their duties and the extent of their rights. These considerations will at once explain the importance of removing the differences which now exist between the mercantile law of the States of Europe and America. These differences may be comprised under the following heads:—

First, in the usages and institutions which they sanction; secondly, in the modes in which they are applied; and thirdly, in the courts and procedure by which they are enforced.

As to the first, we find differences in the rights granted to foreign merchants in different countries; in the ages of majority; in the obligations of merchants to enter particulars into a general registry, and to enrol themselves into some guild. *The law of partnership differs materially in the subject of commandite, &c.* In bills of exchange in some countries *blank endorsements* are valid, in others they are void. *The days of grace differ* in many towns; and, by a strange anomaly, whilst all the world has accepted the Gregorian Calendar, RUSSIA still preserves the Julian, hence the difference of the old and new styles still in operation.

Secondly, as to the modes in which mercantile laws and usages are applied. In most countries in Europe they are reduced *into the form of a code*, which, though of necessity too limited to meet the numberless emergencies of commerce, is sufficiently comprehensive to afford to the merchant a good outline of the law; *in many others they are included in the general law.*

Lastly, with regard to the courts and procedure by which the mercantile laws are enforced. Most European countries possess *tribunals of commerce*, or *district courts*, of a mercantile character, for the speedy and economical settlement of commercial disputes. It may be admitted that the development of mercantile legislation is dependent on the commercial importance of each country, and that certain institutions may be adapted to the peculiar condition of one which would not be adapted to that of another. Nevertheless it is often found that the institutions of the smallest state possess intrinsic value which render them fit for general adoption. The development of moral science, which is greatly included in a commercial code, is the result of juridical and philosophical investigations, and is often the production of a single master mind. Witness, for instance, what Lord Mansfield or Lord Howell did for the commercial law of this country, what Valen, Emerigon, Troplong, Pardessus, or Pothier, did for France, and what Mr. Justice Story or Chancellor Kent did for the United States of America. How important, therefore, is it for the interests of commerce, and for the advancement of judicial ethics, to bring periodically into one focus the experience of the merchant and the researches of the learned. It is to accomplish this that the idea has been suggested to assemble at Paris *a great Congress of Deputies from all Chambers and Tribunals of Commerce, and other Commercial and Legal bodies of different countries*, to discuss the subject of commercial law. The excellent working of such congresses has been exemplified in those lately held at Brussels, in reference to Meteorology and Statistics, both of which have been productive of invaluable benefit to the respective sciences.

At the Statistical Congress held at Brussels in 1853, a resolution was passed expressing a wish and trust that the great differences now existing in the mercantile legislation of different countries may be diminished, if not altogether removed. The Great Exhibition in Paris in 1855, is destined, it may be hoped, to promote in a large degree an intimate connection between all nations; and, in many respects, France, being the heart of the Continent of Europe, possesses facilities, both by her genius, learning, and language, to give a great stimulus to the fusion of interests and to the unity of society. At the head of that great nation, there is one whose qualities are essentially suited to advance these great objects, and whose name is associated with those Codes which have effected a most complete reform in European jurisprudence. Let us seize the great occasion of the forthcoming Exhibition for advancing the interests of commerce. British merchants, whose connections extend over all the world, are deeply interested in everything which can administer ease and security in mercantile transactions. It is above all of the utmost importance to strengthen our commercial relations with France. *We are now receiving from France 20 per cent.* of all her exports (£10,216,832 of £49,330,500 in 1852), and are *sending them only 3½ per cent.* of our exports (£2,736,286 of £78,976,854, in 1852). We stand FIRST in her export list, and France stands EIGHTH in our export list. By an extension of free trade on the part of both countries; by the removal of useless restrictions; by the promotion of international treaties; and by assimilating the mercantile laws of both countries, the commercial interests which at present exist between France and Great Britain may be multiplied tenfold, at the same time that a friendly spirit and a firm political alliance may enable both France and Great Britain to be the champions as well as the guardians of the liberties of Europe, and the pioneers of civilization throughout the world.

SEVENTH ORDINARY MEETING.

WEDNESDAY, JANUARY 17, 1855.

The Seventh Ordinary Meeting of the One Hundred and First Session, was held on Wednesday evening, the 17th instant, William Fairbairn, Esq., F.R.S., in the chair.

The following Candidates were balloted for, and duly elected ordinary members:—

Hicks, Elgar. | Hobbs, Alfred Charles.
Whitehead, James Heywood.

The following Institutions have been taken into Union since the last announcement:—

382. Stanhope, Literary Society.
383. Stratton (near Swindon, Wilts,) St. Margaret Library and Reading Society.

The Secretary called the attention of the meeting to a Portable Stove for heating and cooking, constructed by Price's Candle Company, and proposed by them as suitable for the use of the army in the Crimea. It is simple and compact in its arrangement. The fuel used is cocoa-nut stearine, in cakes, burnt by means of six wicks introduced into each cake. No smoke is produced, and the stove is capable of boiling, baking, and broiling, and the whole is comprised in a cube of about sixteen inches. The cost of fuel burnt is at the rate of one penny per hour, a cake lasting eight hours. One of the stoves was placed on the table, and remained in action during the meeting.

The paper read was

ON THE SMOKE NUISANCE, CONSIDERED MORALLY, HISTORICALLY, SCIENTIFICALLY, AND PRACTICALLY.

BY GEORGE WALKER MUIR.

In entering upon the consideration of the important subject of Smoke Nuisance, permit me to tell you, first, what you are not to expect, and, secondly, what you may expect.

First, then, you are not to expect a learned, original exposition of what smoke is, its chemical constituents, or manner of formation; neither need you look for an ac-

count of some new method of constructing apparatus for its prevention or consumption,—for consumed it may be.

I do not suppose that this preliminary announcement will disappoint you much; you may, on the contrary, probably feel a little relieved from your apprehension of a dry paper, full of chemical analyses or mechanical details; but if you are not to have either an account of what smoke is, or of some newly-discovered plan for its consumption, what, then, are you to have? what are you to expect?

What I propose to offer you this evening is the result of my inquiries and observations, stated in a plain, practical way. These inquiries have extended over a period of several years, and were directed to the ascertaining of the truth, and not to the discovery of some hitherto unknown mode of smoke burning or prevention which I could call my own.

In common with, I believe, ninety-nine out of every hundred persons who have paid even a moderate degree of attention to the subject, the smoke nuisance was, some time ago, a puzzle to me. Time after time, paragraphs announcing the discovery and complete success of some before unknown smoke-burner, appeared in the newspapers, and the assertion was confidently made, that the public might *now* look for the complete disappearance of the nuisance "so long and so justly complained of," and that the authorities might with complete immunity from fear of an unjust interference with vested interests, proceed to enforce the penalties by law imposed. But with all these discoveries of modes of smoke-burning, and with all the threatened terrors of the law, the nuisance did not cease, old chimnies retained their acquired characters as inveterate smokers, and every new one appeared emulous to earn a similar name. Glasgow, Manchester, and other towns where an agitation against smoke has been carried on for years, are by some supposed *now* to be in the enjoyment of pure air, but having resided in Manchester for the greater part of last year, and knowing as much of Glasgow smoke as most men alive, I have little hesitation in saying, that if either of these cities is to be held up as a pattern to others, these others must indeed be in a very horrid state.

When the continuance of the smoke nuisance is considered along with the invariable assertion that by each discovery a saving of at least "twenty per cent. in fuel" might be secured, the surprise is increased to astonishment that manufacturers, generally so quicksighted, should be so blind to their own interests, or so stubbornly determined to annoy the public.

But the mystery so far is unveiled when the reported discoveries are found not to be new things, but old plans revived, and that upon an extended trial they have fallen far short of the success at first attributed to them. Possibly, after a time, we learn that the paragraphs in the newspapers had been penned by the proprietor of the patent, or by some gentleman of the press, who had attended experiments without a knowledge of what had been and could be done, and therefore reported as altogether novel what was new to himself; and that the testimonials had been given by willing employers, on the word of an engineer or stoker, too ready to report favourably when he saw that his master would rather have that than the truth, or, perhaps, with a heart softened towards the patentee by the judicious exhibition of *palm oil*.

I propose to treat this subject under the heads of its moral, historical, scientific, and practical aspects.

Morally, I will consider first, how the matter stands between the offending manufacturer, and the offended public; secondly, how the legislature should treat the question.

Historically, I will consider first, how the question has hitherto been dealt with by the Legislature; and secondly, explain what I conceive to be the mistake all along made.

Scientifically, I will very shortly show how smoke is formed, and explain the principles by which all attempts to prevent its formation or consume it, when formed, should be regulated; and

Practically, I will explain the best modes known to me by which the object may be accomplished.

What, then, are the relative positions of the manufacturers and the public? The latter may be called the plantiff, and the former the defendants. The charge is that they annoy the public and injure the public health, by the discharge of smoke from their manufactories, in consequence of their furnaces being improperly constructed or negligently managed. This statutory offence, when proved, subjects the manufacturer to penalties just as if he had committed an offence against morality and good order. Is this then a proper mode of treating the manufacturer? Is it just to subject him to penalties as if he had been guilty of a breach of the peace or Decalogue? No breach of the peace or Decalogue can be a benefit to society, (neither can the discharge of smoke,) but it is not necessary for any person to break the moral law, while the manufacturer must carry on his operations, and may not be able to do so without the discharge of smoke, which operations do benefit society; thus the discharge of smoke is not necesarily an offence against society, for that cannot be an offence which confers a benefit. There can be no doubt, that manufacturers do benefit the public, and if the discharge of smoke was inseparable from the carrying on of manufactures, then the public is not entitled to interfere with the manufacturer. The private right of each individual, or a number injuriously affected, to protect himself from annoyance and his property from injury, by the operations of a neighbour is another affair, with which I am not called upon to deal at present. I feel very safe in saying that if the suppression of the smoke nuisance involved the stoppage of the sugar refineries of Whitechapel, the breweries of London, or Burton-on-Trent, the cotton factories of Lancashire, the flax mills of Dundee, or the steamers on the Thames and Clyde, the vast majority of the inhabitants would poll in favour of its continuance. This, then, being the relative moral positions of the parties in this cause, it now becomes me to show in what way the public may justly call upon the manufacturer to conduct his operations in such a manner as to give the public all the benefit of his skill and enterprise, without the infliction of annoyance. That the great majority of manufacturing operations may be carried on without the discharge of smoke is undeniable. Do not imagine that I am an out and out defender of manufacturers; all that I say in their favour is this, that since their operations confer a public benefit, the public should, before subjecting any individual to a prosecution, be prepared to show that individual how his operations may be carried on without annoyance to person or injury to property. The manufacturer is not necessarily acquainted with the best mode of constructing or managing furnaces. His conscience will tell him unerringly when he has broken the moral law, and he has no difficulty in distinguishing between right and wrong in such matters; but, though his furnace be constructed on the worst possible plan, though his stoker may negligently manage, and the densest volumes be discharged from it, he may be quite aware of the wrong, but cannot ascertain the right. In dealing with this subject, then, it becomes the legislator, when making laws to compel the consumption of smoke, to provide for the manufacturer such information as will enable him to carry on his trade without being liable to penalties. In examining the acts passed at various periods I will show that what I propose is not a new thing in itself, but only in the time at which the information should be communicated. I will endeavour to show the mistake made in not affording to manufacturers proper information at the time it would be most acceptable, viz., when he is erecting or altering his furnaces, but in placing him under a statutory obligation to construct and to manage them in the most approved mode, without defining what is that mode, or by whom it has been approved, until he is arraigned before a police court, side by side with the drunk and disorderly, the thief and the murderer. He will then, if he knows what he is en-

titled to, demand to know the most approved construction and mode of management, for it is manifestly impossible to show that a furnace is improperly constructed, or has been negligently managed, without showing that a better construction and management might have been adopted, and describing that better construction, and if it could be adapted to the furnace in question.

HISTORICALLY, this subject may best be considered by a review of the parliamentary and legal proceedings regarding it; for, to trace the rise, progress, and present position of the nuisance itself, would simply be an account of the rise, progress, and present position of the manufacturing interests of these United Kingdoms.

An examination of the proceedings of Committees of Parliament of the bills introduced, and the acts passed to suppress the smoke nuisance, brings out two prominent features First, that the legislature had no idea of treating the question other than as involving an offence, which, when proved, should be punished; and, secondly, that an idea prevailed that the object could be accomplished by the adoption of apparatus *per se*, which, having apparently suited in some cases, would suit equally well in all; and that the manufacturer, having been told that means existed by which the purpose could be accomplished, was bound to examine these means and select that best suited for his own case.

It is impossible to remember that for nearly forty years Parliament has from time to time been agitated by the discussion of this question, and that many clauses have been inserted in Acts of Parliament without producing the intended effect, and not to suspect that some latent errors have lurked in the proceedings. These errors consisted in treating the nuisance as one that was to be suppressed in the same way as offences generally, by the fear of punishment; and, when acts have been passed, the leaving their execution in the hands of those subject to their operation, which inevitably led to the very gentle application of the law. But the offence of smoking is one which never will be suppressed by the mere fear of punishment. It is recorded that at an early period a citizen of London was actually put to death, like a robber or a murderer, for the so-called crime of using sea-coal, and thereby making smoke. Certainly the law was then about as stringent as it could be made; much more, indeed, than Lord Palmerston's Act—and yet smoking was not put down.

I am not acquainted with any modern Parliamentary proceedings of an earlier date than the appointment of a Committee of the House of Commons in the year 1819, under the presidency of Mr. M. A. Taylor. That Committee, having examined a few witnesses, reported, July 12, 1819, "that from the advanced period of the session at which the appointment of your Committee took place, it was not to be expected that they could form any ultimate decision as to the precise object of their inquiry; but as far as they have hitherto proceeded, they confidently hope that the nuisance so universally and so justly complained of, may at least be considerably diminished, if not altogether removed."

This report was accompanied by the evidence taken by the Committee, and a considerable number of very well executed plans, with descriptions of the inventions laid before them by Messrs. Gregson, Losh, Steel, Wakefield, Coombs, Brunton, and Walker.

Respecting the inventions of these parties, it is not requisite to remark further than that they exhibit samples of the then general modes by which smoke might be consumed or prevented, viz., a mechanical or constant supply of fuel; the admission of air to the furnace by the bridge or elsewhere; and the plan of alternate firing, or making the flame of one of two or more fires consume the smoke of the other or others. These are the identical means by which it is now proposed to effect the object, while it is nearly forty years since this Committee reported to Parliament.

In the following session a Committee was again appointed; and on the 5th July, 1820, reported "that the revival of your Committee has afforded a full opportuity of ascertaining how far the reduction of smoke in furnaces of different descriptions can be practically accomplished; and the evidence detailed in the appendix will show that the object the House had in view has been satisfactorily and effectually obtained."

This opinion appears to have been based upon the evidence of Mr. Josiah Parkes, Mr. W. Brunton, and Mr. John Wakefield. These were the only professional witnesses examined; the others were gentlemen who had been witnesses to the successful application of the plans invented by those I have named.

I do not think that either Mr. Parkes or Mr. Wakefield was entitled to the credit of being the first inventor of the plans they produced. As I understand their descriptions, in both cases they employed a split bridge, or other opening, for the admission of air, which had been published long before (in 1796) by a Mr. Thomson, of London.

No action appears to have followed upon the presentation of this report, further than the introduction of a bill (28th May, 1821, passed into an act the 1. Geo. IV. cap. 41), by which the judge before whom any party was tried under an indictment at common law for smoke nuisance might, in addition to an order for an abatement of the nuisance, give an order for payment of the costs. Some years afterwards a clause was inserted in an act obtained for the government of the town of Derby. This clause appears to have served as the pattern for all legislative attempts at smoke-burning from that time (1825) until the appointment of a Committee of the House of Commons in 1843, on the motion of Mr. M'Kinnon.

On the 17th of August, 1843, that Committee reported that "it appeared to be the unanimous opinion of the witnesses conversant with the subject, that imperfect combustion arises from a deficiency of atmospheric air to mix with and act upon the inflammable matter at a proper temperature, and under circumstances which must ensure effective operation: that this admission of air, properly regulated, is the great, if not the only, principle of preventing smoke which is generally applicable; and that all inventions for the consumption of smoke (except when the smoke has been separated mechanically by an artificial shower of water produced in a flue constructed for the purpose) are only various applications, in different forms, of this general principle."

The Committee further recommended that "a bill should be brought into Parliament, at an early period of the next session, to prohibit the production of smoke from furnaces and steam-engines."

I do not know whether in 1844 either the Government or Mr. M'Kinnon introduced a bill according to the recommendation of the Committee, but in the year 1845 another Committee was appointed, which reported, on the 9th of May in that year, "that opaque smoke issuing from steam-engine chimnies may be so abated as no longer to be a public nuisance."

"That a variety of means are found to exist for the accomplishment of this object, simple in construction, moderate in expense, and applicable to existing furnaces and flues of stationary steam-engines, as well as to those hereafter to be erected.

"That a sufficient body of evidence has been adduced, founded upon the experience of practical men, to induce the Committee to be of opinion that a law, making it imperative upon the owners of stationary steam-engines to abate the issue of opaque smoke, is desirable for the benefit of the community.

"That in the present state of knowledge and experience upon the subject, it is not desirable to extend the provisions of an Act beyond the furnaces used for the generation of steam for the working of stationary steam-engines.

"That in the provisions of an Act for this purpose, the offence will be best described as being 'the issue of opaque smoke.'"

And also that a penalty should attach to the occupier of the property, or to the person employed in the care of the furnace. And that public functionaries should be appointed to take cognizance of the nuisance, and to bring the offender before the constituted local authorities.

A bill founded upon this and previous reports appears to have been introduced and to have met with great opposition, for the Committee was revived for the purpose of inquiring whether any and what exemptions there should be from its operation.

On the 11th of July, 1845, they reported that "furnaces connected with the manufacture of iron, copper, and coal works, and with distilleries should be exempted."

This bill was not passed, and another of a similar nature, and for the same purpose, introduced into the House of Lords by Lord Redesdale, in the year 1850, and passed, was afterwards lost in the House of Commons.

No further important step appears to have been taken on the part of the legislature, until the passing of the act for London, of which I shall hereafter have occasion to speak.

In the following year, Sir H. De la Beche and Dr. Lyon Playfair, were appointed by Government to proceed to various towns and to inquire into the causes of the nuisance and into the working of the then existing local acts.

Those gentlemen, on the 3rd of March, 1845, (ordered by the House of Commons to be printed, 6th of April, 1846) made a most excellent report.

I could not possibly state the causes of smoke nuisance more clearly than was done by these gentlemen when they class them under these heads :—

1. The want of proper construction and adjustment between the fire-places, and the boiler, and the disproportionate size of the latter to the amount of work which they are expected to perform.

2. The deficiency of draught, and imperfect construction of the flues leading to a chimney of inadequate height or capacity.

3. The carelessness of stoking and management by those entrusted with the charge of the fire-places and boilers.

I beg you to observe that here there is no mention made of any of the then known *inventions* for either preventing or burning smoke, but the causes are said to be *improper construction, adjustment, and management.* The suppression of the smoke nuisance truly is a matter not of *inventions*, but of *dimensions* and *management.* How different the opinions of these gentlemen from that of the House of Commons' Committee, who reported "that the admission of air was the great if not the *only* principle upon which smoke could be prevented," an opinion based upon the then popular theory of Mr. C. W. Williams.

From an examination of the Parliamentary proceedings it is easily seen that the agitation headed by Mr. M. A. Taylor, was based chiefly on the plans of Mr. Parkes, Mr. Brunton, and Mr. Wakefield, while the later efforts of Mr. M'Kinnon were supported by the supposed discoveries of Mr. C. W. Williams.

Scattered throughout the evidence produced before the Committees, the true causes and proper means either to prevent or consume smoke, may be found mentioned, but to suppose that a manufacturer, about to set up a factory, could, by an examination of that evidence, decide for himself which plan was most suitable for his circumstances, is as reasonable as to imagine that the perusal of a standard authority on law, or medicine, would enable a man to convey his own property, conduct his own causes, or cure the ills that ail him.

I have given this history of Parliamentary proceedings in a great measure with a view to direct the attention of parties in search of information on this subject to the reports of the committees, for, though not fitted to be the guides of the owners of factories in general, yet one having the experience necessary to prevent the reception of error (sometimes published under very high authority), may acquire a very considerable amount of knowledge of the subject by their perusal.

The Derby smoke clause, requires that all furnaces for purposes of trade or manufacture, "shall be constructed in the best manner known and practised, so as to prevent or consume their own smoke." It is not requisite to notice the other provisions of this clause regarding notice in writing, &c., &c. The leading principle, and a sound one it is, is that parties are to use the best known means for the prevention of nuisance, (the idea of prevention did not originate with Williams). I am acquainted with but one local act in which the smoke clause wants the proviso as to the "best means." That act relates to Halifax, in Yorkshire, and, as I read it, makes the prevention of smoke imperative, *whether* it be *practicable* or not.

It is unnecessary to quote the clauses in the acts relating to other towns, for though there are differences, still in their main provisions they are the same as the Derby clause, but there are two cities to which clauses apply where the provisions are in one case so different from all others, and in the other of so recent enactment, as to make them worthy of special notice. I refer to the acts relating to the cities of Glasgow and London. I need hardly tell you that when an act provides that parties are liable to punishment for the non-performance of a statutory obligation, the failure to perform must be proved before punishment can be inflicted; now the statutory obligation is to construct and manage furnaces so as to prevent or consume their own smoke. It is not the discharge of smoke that is the offence; it is the failure to construct and manage. Now to prove this offence, it appears to me that the complainant must prove, not that other persons' furnaces are constructed and managed so as to consume their own smoke, and, therefore, that those in question may also be otherwise constructed and managed, but that those in question are neither properly constructed or managed. Now that proof cannot consist in an inference that because their smoke is not consumed, therefore their furnaces must be improperly constructed or managed, but the complainant must describe the construction of the smoky furnaces, and the better construction that might be adopted, and show the difference between the two.

Now, the peculiarity in the Glasgow Act is that the question as to whether a furnace is, or is not, properly constructed shall be referred to *three engineers or other persons of skill in such matters*, who shall examine the furnaces, and report to the Court the alterations, if any, they would recommend to be made; and there is a provision which does the greatest credit to the framer of the act (whoever that was), and it is this—that persons of skill are to examine *the relative dimensions of the furnace, boiler, chimney, and cylinder of the engine, if any.* In the hands of an honest corporation, this act would long ago have sufficed to free Glasgow from furnace smoke. As an Act of Parliament it is based on the soundest principles of any on the Statute Book referring to the smoke nuisance. The great defect in the Glasgow Act is, that there is no provision made for the owners of furnaces having the advice of engineers or other persons of skill until they have been indicted. They are left to find out for themselves, and if they fail, down comes (or should come) the law upon their head.

I will now take a glance at the last effort in the way of legislation, the Act 16 and 17 Vic., cap. 128, the short title of which is "Smoke Nuisance Abatement Act, Metropolis."

It is said that a coach and six may be driven through almost any Act of Parliament; this London Act might be pierced by a hand-cart. There is first the old gap, "the best practical means," a gap that leads to the question, "what is the best way of burning or preventing smoke?" Thus this act restricts the answering of this question, declared by Mr. Fairbairn and Dr. Playfair to be among the most difficult to deal with, to the constables of the Metropolitan police force, who alone are authorised, with or without assistance, to enter upon premises, to

inspect the furnaces, and to inquire into the manner of carrying on the business therein. There is another pretty wide opening in the shape of a proviso, that *all the smoke need not be burned*, leading to the question how much will satisfy the inspecting constable or the neighbourhood, for the discharge must be great enough to annoy the neighbourhood. It is very clear *that* gap will be a great deal wider in Whitechapel than in Belgravia. It is very possible a great deal of evidence has been produced in the cases under this act which has not been reported, but so far as I can understand the cases as they are reported, the parties indicted have not generally made any strenuous resistance, and thus no decision of an authoritative character has been obtained. The right to institute proceedings being in the hands of the Government, is somewhat of a guarantee that the law will be enforced, but it may not be so, and possibly ere long the excitement will pass away, and the grasp of the law will be relaxed. Possibly also the administration of the smoke department may pass into other hands than Lord Palmerston's.

When we attempt to acquire a knowledge of the combustion of fuel and the prevention of smoke, we are bewildered by the variety of opinions advanced on various branches of the subject. We see it asserted by one authority, with a great array of chemical knowledge, that smoke is incombustible, and if once formed cannot be consumed. One party insists upon the air being heated before its admission into the furnace—another prefers to have it cold. The bridge of the furnace is said by one to be the proper place to admit it, whether cold or hot; while another insists upon admitting it at the door. Some contend for a constant, others for a graduated quantity. Much learning has been thrown away in attempting to define what smoke is, but it has always appeared to me that, so far as the public are concerned, the inquiry need not be pushed very far in that direction. Smoke, as it appears to the eye when issuing from a factory chimney, is a compound of soot, dust, steam, and gas, of the same description as is produced and distributed by the gas companies. If the first or sooty portion be removed, I imagine the public should rest satisfied. When that is accomplished what remains to be done is more a question of economy for the factory proprietor than for the public. But there are some things connected with this part of the question which should be noticed before entering upon an examination of the practical:

I am not one of those who assert that smoke is *directly* prejudicial to health. Indirectly it will, by obscuring the light of the sun and by making the ventilation of our houses a question of two evils—a close or a sooty atmosphere—injure the health of those exposed to its influence; therefore, though it may not directly injure the health, yet, as it does indirectly and undeniably lessen our enjoyments of life, it is a nuisance, and, when possible, should be abated. It is sometimes gravely asserted that if smoke be consumed, the gases produced by the process are more detrimental to health than the smoke itself, an assertion very easily disposed of.

As the burning of smoke is the consumption of the carburetted hydrogen gas evolved by the fuel, it follows that the product of that combustion will mainly be the same as that from the consumption of gas in our houses. That product is water, and I am not aware of any very hurtful consequences attending its discharge into the atmosphere. The proportion of carbon consumed at the same time will not add greatly to the quantity of carbonic acid gas, which is the principal product, and is not considered so detrimental as to warrant great expenditure for its removal. On the point of economy I may here say a word. I believe that the constituent parts of the New castle coal, which is chiefly used in this city, are about 85 parts of carbon, 5 of hydrogen, 7 of azote and oxygen, the remainder of the 100 being ashes or incombustible matter. The smoke, then, which affects the public, is mainly composed of the hydrogen and such portions of carbon as are thrown off with it; and, as the proportion of hydrogen is only five per cent. of the whole, it is evident that no room exists for effecting a saving in fuel to the extent of from seventy-five down to ten per cent. I never yet have been able to get evidence to satisfy me that the direct saving from the burning or prevention of smoke was over five per cent. I have known cases when no difference resulted in the quantity of fuel consumed, whether smoke was consumed or not.

The conditions requisite for combustion are, that the subjects of combustion—by which I mean the fuel and the oxygen—be brought into contact, and subjected to a heat sufficient to unite them, and the manner by which these conditions may be attained I shall consider as the practical part of the subject. When these conditions do not exist, the formation of visible smoke will be the result of the imperfect combustion consequent upon their absence. But the smoke discharged from furnaces is generally the result of imperfect combustion consequent upon the stoppage of the process after it has been begun. This stoppage in many cases is caused by deficient draught; from want of air the heat necessary for combustion is not maintained. But a common cause of dense volumes of black smoke is not so much the want of draught, as the stoppage of combustion by the products of the fuel nearest to the grate bars being passed through a layer of fresh coal laid upon the incandescent fuel. By far the greatest quantity of smoke is caused by the passing of the heated gases through this layer of cool fresh fuel, and the better the draught, the blacker and more abundant will be the smoke. Smoke, then, is caused by imperfect combustion, either from want of air, or from the cooling of the products of one part of the fuel by their passage through another part.

The means, then, by which the formation of smoke is to be prevented, or consumed when formed, are draught, adequate dimensions of boiler, and good management.

Adequate dimensions of the flue and chimney are primarily necessary to prevent or consume smoke. Adequate dimensions of the boiler are not requisite to consume smoke, but to consume it *economically* and consistently with the performance of the work to be done. Draught is the first requisite, for without it smoke can neither be prevented from forming nor consumed after formation; but as boiler power is frequently said to be *necessary* for the prevention or consumption of smoke, I will now show that it is necessary only so far as the economy of the process is concerned, and also as regards the capability of the boiler to raise the requisite quantity of steam for the work to be done *in a certain time*. Draught is necessary to produce the heat, and boiler space is required to absorb it when produced.

To many it appears to be a very extraordinary thing, that when smoke is burned, less steam is raised in a given time. It seems sound reasoning to say, smoke is fuel, and since steam is raised by the burning of fuel, the burning of smoke should raise steam. This is so far correct; but I have observed, that in many cases where smoke is consumed by the admission of air above and not through the fuel, there is not so much coal consumed; and since coal is also fuel, it is evident that the burning of smoke may, by decreasing the consumption of coal, lessen the heat of the furnace, and thereby reduce the quantity of water evaporated *in a given time*. This I will endeavour to prove by reference to the diagrams on the wall; but as there may be some here who are not acquainted with the construction of furnaces, I will give a very familiar example by refering to the operation of blowing up a domestic fire by putting a cover in front of the grate and forcing all the air to enter by the bars through the fuel. When this is done the fire burns with greater intensity, and a much greater heat is produced, because a greater quantity of fuel is consumed in a given time, consequently more steam would be raised in that time, if the heat be applied to that purpose, than if the fire were allowed to burn slowly.

The process of combustion in the furnace of a steam-

boiler is identical with that in the domestic grate, except in so far as the mode by which the air is supplied. In the steam-boiler furnace, as in the open air, if the air be admitted above the fuel, then it is consumed less quickly and the rate of evaporation is slower, and as the most active part of the boiler is that right over the fire and for a short distance beyond the bridge, it is evident that any reduction of the heat of that fire will have to be balanced by increased heat in the flues, and whether that will or will not be the case when smoke is burned, will depend upon the relative constituent parts of the fuel, the setting of the boiler, and the power of the draught. Nothing can be more perplexing and unsatisfactory than the comparative results of experiments made in different places, when the construction and setting of the boiler, with the dimensions of the several parts, not only of the boiler, but of the flues and chimney, are not also given.

Boiler power, then, is not in itself necessary for the prevention of smoke by the admission of air,. but solely as regards the raising of a certain quantity of steam in a given time. If air be admitted above the fuel, the intensity of the fire is lessened, because less air will pass through the bars, and as the fire on the bars is, compared with the flame in the flues, the more powerful evaporator, it follows that the admission of air above the fuel lessens the rate of evaporation. If you will look at diagram No. 1., you will see represented the incandescent fuel on the bars, and the fresh fuel above the incandescent; now the reason why the admission of air into the furnace above the fuel, has the effect of lessening the rapidity of combustion, is this: The size of the flues and chimney, and the heat therein, regulates the quantity of air which the fire will draw. If air be admitted above the fuel, or into the flame bed at the bridge, the quantity passing through the bars will be lessened in proportion to the quantity admitted elsewhere. The fresh fuel being placed over the incandescent, it is apparent that the fresh will be consumed quickly or slowly in proportion to the degree of heat which passes through it from that on which it is placed. If a quantity of air be admitted above the fuel, that which passes through the bars will be lessened, and as the rate of combustion depends on the supply of air, that rate will be lowered when the supply is reduced. It will thus take longer to ignite the fresh fuel, and consequently the time during which the furnace will be cooled down by the fresh charge will be lengthened.

The diagram No. 1, shows how smoke is formed. You will observe that the fresh fuel is laid upon the red-hot coal. That part of the fuel which is in contact with the incandescent portion is immediately ignited, and the products pass upward, but as the mass above is cool, the products are cooled in their way upward, and smoke is formed. That is the whole affair; there is no mystery about it; and any parlour fire which is supplied with fresh fuel will furnish an example of it.

Now, I am sorry to differ with Mr. C. W. Williams, when he says it is impossible to consume smoke if it be once formed. It can be consumed; by that I mean that the gas, vapours, smoke, or whatever else it may be called, which, whenever formed, and permitted to pass through the flues and chimney into the air the constables of the metropolitan police would call smoke, can be consumed, and that is all the public care about.

Observe diagram No. 2. There is the smoke formed from the fresh fuel; it passes to the bridge, when it meets with a supply of air; and if the furnace be hot enough to supply the initial heat, it—that is, the smoke—will ignite, and be consumed to all practical intents and purposes. I have seen smoke consumed a thousand times, and I consider it mere trifling to assert the contrary; and to rush into the bosom of high chemical authorities for proof. Dr. Reid, in his evidence before Mr. M'Kinnon's Committee, very justly remarked how inconsistent it was for parties to assert that smoke could not be burned, when their own diagrams showed it formed in one part of the furnace and consumed at another.

I have said that the smoke will ignite when it meets the air admitted at the bridge, provided there be heat enough to set it on fire. This brings me again to the question of draught, which I have already touched upon.

Draught is necessary to consume smoke, because otherwise the heat of the furnace would not be high enough to ignite it. If you will observe diagram No. 2, you will see that the smoke passes over the red coal at the bridge, and at this part the air is generally admitted. If the draught be not keen enough to cause the red coal to burn briskly, the heat will be insufficient to ignite the smoke and air, and the desired effect will not be attained. Draught (that is a sharp draught) is not required but at this time, so that slow combustion is quite consistent with the occasional use of a quick draught, for it is a very easy matter to lower the damper and to slacken the draught when it is no longer required. I have not prepared any tables of draughts calculated from given dimensions and degrees of heat in the chimney. When I see a furnace in operation, I can tell at a glance whether or not the draught be sharp enough to effect the consumption of the smoke. A good draught in a furnace is a main element in its economy. I have known a ton of coal saved in a week by adding to the height of the chimney; the sharper the draught the greater is the heat, and the greater the heat the more perfect is the combustion, and the more perfect the combustion the greater is the economy, and, with good management, the less the smoke,—thus draught s the prime requisite both for economy and for the consumption of smoke.

The most usual mode of burning the smoke of furnaces is by admitting air above the fuel; there are others of which we may hereafter take notice. I will now consider (1) the admission of air with respect to its temperature; (2) whether it is better intermittent or constant; (3) whether admitted by one opening or many; (4) whether at the bridge-door, or sides of the furnace.

1. About twelve years since a warm controversy was carried on between the advocates of hot or cold air, and it has been renewed among the patentees of the new plans. On this subject I have an opinion that it does not matter very much whether the air be or be not heated before admission into the furnace, *first*, because though it is heated, the degree is not very high, and *secondly*, because it is generally heated by the furnace itself, and in that case, heating the air is like robbing Peter to pay Paul. When the air is heated, a larger aperture is required for the admission of the required quantity.

Certainly, when the aperture is of the requisite size, it is so much gained, it, before entering, the air receives heat which would otherwise be wasted.

2. The advantages of a constant or intermittent supply will depend (1) upon the quantity of hydrogen in the fuel; and (2) upon the depth of fuel on the bars. When the furnace is newly supplied with fuel, and is required to mix with the hydrogen when the fuel is incandescent, and the coal laying so thick on the bars as to produce carbonic oxide, then air is required to mix with that gas; but when the draught and depth of fuel are properly adjusted the air should be shut off, when the fire is clear, as, when the product of combustion is carbonic acid gas, the addition of a further quantity of air is prejudicial, by damping the draught through the bars, without compensating by the production of flame in the flues.

3. The two leading assertions of Mr. C. W. Williams are—that smoke once formed cannot be consumed in the same furnace; and that for its prevention the air must be admitted in thin films, or in slender jets. Smoke may be consumed, and its prevention is not to be effected by the admission of air above the fuel, whether in one volume or in many small ones.

Diagrams Nos. 3 and 4, show Mr. Williams's plan as practically applied; and having seen and thoroughly examined a number of furnaces fitted with his patent, I have found that, in point of economy and smoke prevention, the effect is much the same. No doubt the more completely

we can mix the air and gases the more complete will be the combustion, but there are practical difficulties in the way of admitting air by many perforations, and the mixture can be effected very well indeed by having the after wall of the split bridge a few inches lower than the front, and having a flame-bed so large that the gases and air will circle about on their way under the boiler, and thereby be mingled. I do not expect that my opinion will be considered of so much value as that of Mr. Williams, I therefore deem it necessary to fortify my position by the following quotation from the evidence of H. Houldsworth, Esq., before Mr, M'Kinnon's Committee, in 1843, and this I do the more readily, that Mr. Houldsworth is a gentleman upon whose experiments and opinions Mr. Williams himself sets a great value.

Q. 1056. *Mr. Brotherton.*—What is your opinion with regard to admitting the air by means of one large aperture or by many small ones; does that make any difference? —I think it does in favour of the small apertures; *but in our case certainly not to an extent to justify any increased outlay in consequence.*

Q. 1057. *Chairman.*—Is it your opinion that if the air comes in in a body, it will have the same effect in mixing with the hydrogen as if it came through small holes?—I think it essential that the air should mix with the gases, but that in some furnaces at all events there are eddies or certain drafts which produce the effect of mixing the air and the gases instantly, *even though the air is admitted in a large body.*

Q. 1058. Still, from your evidence, it appears there could be no harm by introducing it through small apertures? I should prefer that theoretically. I am persuaded that is the right principle.

Q. 1059. *Mr. Beckett.*—You have not tried the admission of air through small holes in various places, supposing the bricks perforated, and the air coming in gradually at the sides. You have not formed an opinion upon that?—I feel quite justified in saying that *it is quite immaterial where the air is admitted,* provided a judicious quantity is admitted, and it be into or about the furnace. I admit it in four different ways, and they are, as near as I can find, *equally effective.*

It is unnecessary for me to add one word to show the small practical importance to be attached to the admission of air in finely-divided streams *above the fuel.* It may not be out of place here to direct the attention of those who wish to pursue this subject further, to the evidence of Mr. Muntz, M.P., Dr. D.B. Reid, Mr. Houldsworth, and Mr. Fairbairn, as the most valuable part of the mass taken by the Committee in 1843.

4. In practice, I have known the air to be admitted at various parts of the furnace; the places most usually selected are first, the furnace door, secondly the arch over the dead plate, when the setting of the boiler will admit of that being done, thirdly the bridge, if through the dead plate. I do not think it matters much, if anything, which of those plans is chosen, but if I were driven to make a selection, I would choose either the bridge or the dead plate. The bridge has been objected to because, if not provided for, the intensity of the heat consequent upon the inflammation of the gases is so great as to injure the boiler. That may have happened in some instances, but I have known boilers used for a considerable time without showing any injury arising from that cause.

I believe the best place to admit the air is through the bars. That mode fulfils Mr. C.W. Williams's theory exactly, for the passage of air through the spaces between the bars is truly in thin films. I have observed of late thin bars coming into use as something new; they are particularly referred to in the evidence of Mr. Molesworth, the Vicar of Rochdale, before Mr. M'Kinnon's Committee.

But let air be admitted over the coals at any part of the furnace, the smoke will not be consumed unless the furnace be at the same time well managed. By this, I mean that the coal be supplied regularly, and not in too great quantities, and not be laid over the whole mass of red coal. It will not matter one whit whether air be admitted in one volume or in finely-divided streams or jets, if the fresh coal be laid all over the red, as is shown in diagram No. 1. If the layer of fresh coal be very thick, say four to six inches, the smoke will be very black, and last a considerable time. If it be thin, say not more than two inches, the fire will pass through in a short time, the gases will be ignited as they arise from the fuel, and little smoke will be seen. Stokers are generally averse to fire thin, as thin firing involves frequent firing, and that involves trouble. It is usual, when giving instructions to stokers, to recommend that the fresh fuel be placed on the front, and the red shoved to the back, as in diagram No. 2.

I lately saw at the silk mills of Messrs. Walker, in Salford, a mode invented by their manager, Mr. Bury, which is better. It is to draw the red coal to the front and throw the fresh to the back. When this is done, the flame from the front plays over the fresh fuel and ignites the upper portion, thus burning it downwards. The fire is also carried forward by the draught, and the whole mass is soon ignited. An immense quantity is thrown on at once, the furnace being supplied but thrice per day. My attention was directed to this mode by Messrs. Holcroft and Hoyle, of Manchester, and I have great pleasure in making it widely known. It is shown in diagram No. 5.

When smoke must be burned, the fire must be well managed, and I attribute the saving frequently ascribed to the adoption of smoke burning, more to the *management* than to the *patent.* Hitherto, I have referred to smoke combustion by the admission of air over the bars or at the bridge beyond; but there are other modes by which the object may and has been accomplished. The alternate firing and gradually feeding two or more furnaces united in a mixing chamber, and firing them not simultaneously, but alternately, is, of all the modes of smoke burning, the most effective; but it requires a good though not a keen draught, and ample boiler power.

This principle of firing two or more furnaces alternately, appears to have been first patented by Losh, in 1815, just 40 years ago, (another proof that there is nothing new in smoke burning). The patentee encumbered it with dampers, to throw the smoke back on the clear fire, a quite unnecessary addition. It was again patented by Thomas Hall, in 1839, and this identical plan was revived in 1851 at Glasgow, and once more made the subject of a patent. It may have been patented in other instances with which I am not acquainted, but it is somewhat remarkable that the mode most in favour at the present day among engineers, should have been discovered so long ago as 40 years, and have remained so little known. It shows very clearly that knowledge is not to be communicated by the collection of information and its publication in blue books or pamphlets. Mr. Losh was a witness before Mr. Taylor's committee in 1819, and plans showing his method are given in the appendix to the Committee's report. They are repeated in Mr. West's pamphlet, published at Leeds in 1843, along with those of Mr. Thomas Hall, and I was very much struck some weeks ago, when conversing with Mr. Houldsworth, to hear that gentleman say that the next boilers he had made would be on the alternate firing principle, but with a furnace at each end of the boiler instead of at one, this being nearly identical with Mr. Losh's plan.

There remains but the principle of gradually supplying the fuel by means of machinery, as has been done by Brunton, Stanley, Juckes, Godson, and Hazeldine. There are others, but I have named these because they are the best that I have seen of the class. It is unnecessary for me to explain or describe them. I have seen them all in successful operation, but have had something to do with Juckes's at Glasgow, where, I am sorry to say, a gentleman adopted it on my recommendation, and after spending £500 was forced to abandon it, on account of the extra consumption of fuel, not less than 45 per cent. This

arose from the fuel not being suitable, but it would take too long to explain how. I am satisfied that all these very elaborate and expensive appliances are altogether unnecessary when the boilers, furnaces, flues, and chimney are of dimensions adequate to perform what is expected of them. To expect that smoke will be burned by the simple application of inventions, is altogether futile.

I may now do what I should have done at first, apologise for my presumption in appearing before you on a subject which authorities so high as our Chairman and Dr. Lyon Playfair, have acknowledged to be among the most difficult they have ever tried to deal with. After having seen hundreds of furnaces, in all parts of the kingdom, and examined the plans and descriptions contained in many reports and pamphlets, I am of opinion that our knowledge of the subject is not much, if at all, superior to what it was twenty years ago, and that the success of the most modern invention is not greater than those of that time. We are told in the testimonials of that time, that the smoke was reduced to not more than is seen from any kitchen chimney, and with a saving of 20 per cent. at least. I challenge the proprietor of the latest patent, or of any taken out during the past 12 months, to produce better results. This stationary position of affairs is to be attributed to the nuisance having been dealt with by the legislature as one to be included in the category of moral offences, and to the all but universal idea that it was to be got rid of by the adoption of some peculiar invention or apparatus, and the consequent neglect of sound principles in the construction of furnaces. I consider Mr. Fairbairn's paper, read at the meeting of the British Association in 1842, to be a very valuable guide in estimating the proper proportions of the furnaces and boilers, but I was much disappointed to find that Mr. Fairbairn had not furnished data from which the area of the flues and chimney, as well as the height of the latter, might be ascertained.

It is the duty of the Government of this country to ascertain the proper construction, and to make the best relative dimensions known, and only to prosecute when parties obstinately refuse to accept advice, and who yet continue to have smoke discharged from their factories. When Dr. Neil Arnott was asked by Mr. Beckett (a member of Mr. Mc Kinnon's committee) what course he would recommend the legislature to adopt, he suggested that the Board of Health should institute experiments, and said that it would be wrong to insist upon persons doing what they were not told how to have done. It has always appeared to me as humiliating to the Government of this great country to be the prosecutors of parties whose furnaces are no worse constructed than those of many departments of the Government itself, and to see their counsel, Mr. Bodkin, able only to say, "Smoke can be consumed, and you must do it *somehow*."

I shall be surprised if the present crusade against smoke is successful. Prosecution and fines have been inflicted elsewhere, and yet the nuisance remains undiminished. Mr. Buchanan, the United States Minister, is reported to have said, at a civic feast in this city, that his Government had instructed him to watch Lord Palmerston's proceedings for the suppression of the smoke nuisance. It looks like stepping from the sublime to the ridiculous to think that the minister will have to report to his Government that Lord Palmerston proceeds against smoking just as he would against drinking or thieving. It is possible to live without getting drunk, or committing theft; therefore, drunkenness and theft should be punished. It is likewise possible to consume coal in furnaces without allowing smoke to be discharged into the atmosphere; therefore, those whose furnaces discharge smoke into the atmosphere should be punished;—such is the reasoning, but the cases are not parallel. I submit that the parties properly liable to punishment are not the owners of the furnaces, but the engineers who made them. Smoke may be consumed in furnaces properly constructed; therefore, those who improperly construct furnaces ought to be punished, is a sounder argument.

Let the Government remit this subject to three persons —say Mr. Fairbairn, Dr. Neil Arnott, and Dr. Lyon Playfair—and there will be good hope of their being rightly informed. The course at present pursued is not creditable to the Government of a country pre-eminent for scientific knowledge and a love of fair play; but is another instance of how far we are behind other nations in the organisation of adequate means to secure an end.

How is an attack on the smoke nuisance usually begun and carried on by us? It is thus: some member of a Town Council, or Local Board of Health, happens to meet with, or is waited on by, some person who has at last found out a way for furnaces to burn their smoke. With a laudable desire to benefit the public, the member moves that a committee be appointed on smoke nuisance; —he waits on some patriotic smoker, and introduces his friend the inventor, and an arrangement is made for the alteration of a furnace on the new plan. When completed, the committee are invited to call at the factory, and see for themselves; they attend at the appointed time. Ten to one but the new plan is on the admission-of-air principle; accordingly, the valve is opened, and shut; dense volumes of smoke are allowed to gush forth, and at the word of command are arrested; the committee are delighted; perhaps they partake of cake and wine, but whether or not, they leave fully assured of the fact that smoke may be burned, and resolutely determined to vote for the immediate adoption of stringent measures for the suppression of the "nuisance so long and so justly complained of." Probably the gentlemen of the press are also present, if so, paragraphs appear testifying to the certain success of the invention, and trusting that the authorities will not fail to now enforce the law which for so long has been suffered to remain a dead letter. But ere long the Committee learn that the apparatus has been burned out, or that the steam can not be kept up, or, more likely, they delay proceeding further until a greatly superior plan, invented by a person of experience, is fully matured and tested. By the time this is done, some other inventor, attracted from a distance by the stir which he learns is being made, comes down, and ere long the Committee become bewildered among the many plans, each having its advocate and all their enemies, and at length they get disgusted, and the proceedings die off. After the lapse of a few years, some other members get into the same circle, and do the same round of supposed discovery, confident hope, and eventual disappointment. This arises from want of organisation for the careful collection of information by persons appointed for the purpose. Suppose Dr. Arnott's suggestions had been recommended by the Committee in 1843, and adopted by the Government, long ere this there would have been towns free from smoke, provided the people in them desired that consummation. Suppose the Town Council or the Local Board of Health resolved to move in the matter, they would apply to the persons appointed to supply information and assistance. An officer would be appointed to survey the manufactories, and to state what means, if any, could be adapted. He would first make himself acquainted with the qualities of fuel used for manufacturing purposes. He would visit and inspect each manufactory, and examine into the manner in which the furnaces, &c., are constructed and managed. This done, he would be able to specify what were the best means, if any, for each particular case, according to the circumstances; and if his recommendations were voluntarily adopted or enforced by the law, the town would get rid of the smoke, and the manufacturers would, after a time, find that a benefit had been conferred upon them. If the money spent upon patents for smoke consumption had been spent in the organisation of such a system of procedure, we should at this date, instead of being little, if any, better than we were in 1843, in either theory or practice, have had the satisfaction of knowing how much we could attain, and have had a ten years' ac-

quired experience in the practical application of sound principles.

To secure the benefit of such a system it is not necessary that the Government should interfere. The local municipal authorities of any town may adopt it for themselves.

If, instead of appointing an inspector to watch chimney-tops and push patents, they appointed an engineer to inspect furnaces, they would take the first step in a right direction. It is amusing, to one who knows that no particular plan will do in all circumstances, to be asked, when the smoke nuisance is the subject of conversation, and he has said it may be abated, "What is your plan?" As well ask an engineer what plan he would adopt to supply a town with water. There may be a variety of places from which a supply may be drawn, but the principle of gravitation is the best. So with furnaces; there are many forms of boilers, but of whatever form a boiler is constructed, the dimensions must be sufficient. Once more I have to repeat, that the smoke nuisance involves the consideration of *dimensions*, not *inventions*, and the sooner this truth is recognised and acted upon, the sooner will our cities be freed from the nuisance of smoke, and our Government freed from the reproach of attempting to do by sheer force what could have more speedily and economically been done by instruction.

DISCUSSION.

The CHAIRMAN said that having heard the very interesting paper laid before them by Mr. Muir, he was sure there were a great number of gentlemen present who would wish to express their sentiments on the subject, but as their time was very limited, each gentleman would express himself as briefly as possible on the best mode of suppressing the nuisance, the consideration of which had been so ably brought before them.

Dr. NEIL ARNOTT, F.R.S., having been called upon, stated that his attention had been more particularly directed to the means of getting rid of smoke from the domestic fire-place than from the furnaces of large manufactories, and he felt that it would be more interesting to hear the opinions of those who had devoted their attention to that portion of the subject, than for him to occupy the attention of the meeting.

Mr. LEE STEVENS would offer a few observations on the paper which, he was sure, all must have felt gratified in hearing, it having been laid before them with so much gusto and humour, and so divested of technicalities and dry details, as to make it a pleasure to listen to it. He was a member of a class of society who, as inventors, had directed their attention to the subject of the consumption of smoke. He did not, however, profess to occupy the entire field, because he believed there were very many inventions on the same subject of great merit, and that manufacturers should be left to determine for themselves which of them were best adapted to their particular works. He agreed with Mr. Muir that, with sufficient dimensions and with a sufficient draught, the smoke might be consumed without the aid of mechanical inventions, but without those requisites, it could not be consumed excepting by the aid of the inventor. He noticed one observation in the paper, that, although these inventions went to the reduction of the smoke carried off with the gas, there was no saving effected in the consumption of fuel, nor a greater quantity of water evaporated. [Mr. MUIR—In a given time.] Now, from some experiments made with his (Mr. Stevens's) apparatus by Mr. Robert Galloway, the engineer of the London and Westminster Steam Boat Company, in which the time occupied was as nearly as possible the same, it appeared that with 1lb. of coal, 1·48, or nearly 1½ lb. more water was evaporated by the use of the apparatus than without it—the quantities standing respectively 7·38 and 5·9 lbs. of water to the lb. of coal. He did not think it at all necessary for him to refer to Mr. Muir's opinions with regard to different inventions alluded to, as all the inventors had to do was to bring forward their inventions, and leave it to manufacturers to determine for themselves which would best suit their particular wants. He had been invited by the Society to attend that meeting, and to furnish them with his plans and models, and he had done so, being perfectly ready to leave it to gentlemen to form their own opinion upon their value. He might, however, be allowed to say that he had supplied the Society with a list of more than one hundred establishments in which his inventions had been applied, amongst which were the *Times* newspaper, Messrs. Charrington, Head and Co., the brewers, Messrs. Miller, Ravenhill, and Co., the engineers, and various other firms of equal standing. He might therefore be allowed, on the part of the inventors, to enter his caveat against the assertion that they were doing nothing to abate the nuisance. He was pleased to hear Mr. Muir refer to the plan of feeding furnaces alternately, as adopted by Messrs. Bell, of Newcastle; but was that gentleman aware that the firm alluded to were making a series of experiments with a view of having each furnace dependent only pon itself, and abandoning the system alluded to. He would not detain them with details of his own invention, as those who wished for further explanations could see him at his own office, where he would be happy to show them his drawings, and give them every possible explanation. There it was he transacted his business, and not in the hall of a Society like that which he then had the honour of addressing.

Mr. G. F. WILSON might speak to the care and trouble with which Mr. Muir acquired part of his valuable information, but he would rather confine himself to a few words upon Hazeldine's furnace, which he considered the best, because it was the cheapest and simplest, of the moveable-bar smoke-consuming furnaces. He might premise, however, that no member of Price's Candle Company ever had any interest in any smoke consumer. He would now give the results of an ordinary twelve hours work in a Hazeldine of twenty-four feet fire space, and would leave engineers present to form their own conclusions.—The coal used was common London "small," taken from a heap where it had become wet from exposure to the weather. London small coal was at least 6s. a ton cheaper than common steam coal, Hartley's, for instance. In 12 hours the coal consumed was 28 cwt., and the number of pounds of water evaporated was 21,600; therefore 6·88 pounds of water were evaporated by one pound of wet coal. The cost of a 24 feet Hazeldine was £90; that of a common fire-bar furnace, was, he believed, £25. The extra cost of the smoke consumer was thus £65. He considered that with a furnace working night and day this amount was saved twice in the first year.

Mr. HENRY MAUDSLAY was sure all would feel that their best thanks were due to Mr. Muir for his very valuable paper. It was true that smoke could be prevented if all their apparatus were of sufficient dimensions for their business; but without the aid of mechanical inventions it would be impossible to prevent smoke if they attempted to make a ten-horse power boiler do the work of a twenty-horse one. In most establishments the business had gradually grown upon them, and many manufacturers found that they had only to increase the quantity of coals used to do any amount of work they required. In doing so a great amount of smoke was made, and it was shown to be a false economy to employ an old boiler to do the work inefficiently, as they had no real return for the larger quantity of coals consumed excepting up the chimney. As to smoke consuming apparatus it was evident that there were different forms of boilers to be considered, and that any one apparatus could not be applicable to all kinds. The furnace for a steam-engine would be different to that for a glass-works, a pottery, a soap-manufacturer, or the many other trades of which he could go on with an almost innumerable list. He might be permitted to say however that the admission of air in small quantities might be beneficial. If a

pipe was passed through the fire for the purpose of heating the air, they would find that all the economy obtained by the use of heated air would be regulated by the quantity of fuel employed in heating it. There were some furnaces to which mechanical inventions could not be employed for destroying the smoke, such as furnaces for working the ironmasters' hammers, &c., therefore it was impossible to apply one mode of effecting their object to every case. That kind of furnace was most economical which depended upon the exertions of the stoker, as the effect produced was obtained out of the outlay for his wages, instead of being debited against extra expenditure for mechanical improvements. He had lately seen a furnace of the description he had mentioned, with which he was much pleased, as it fully answered the purpose of getting the saving out of the wages of the fireman. In the first lighting of the fire, as the coal was thrown on it was well known that it came into a state of semi-coke, and whilst properly igniting threw off large quantities of smoke. The furnace to which he alluded was under an old patent. He had no interest in it himself, it being the property of a poor man named Ford. On each side of the furnace, above the fire bars, were lines with slides, by which they were worked under the fire, and the furnace was continually supplied with new coal without the door being opened at all, and there was no medium for the sudden or undue admission of air. The lines having been worked across the fire-bars, the latter were lowered by a rack, and the stoker could readily clear away the clinkers and put on 6 or 8 inches of coal. They were then brought up under the top as before, the lines withdrawn, and it became one fire with the live fuel at the top. The coals gradually became ignited from those above them, and the gases escaping through the fire, there was no smoke produced.

The CHAIRMAN—There was, in fact, a double set of fire-bars.

Mr. MAUDSLAY—Precisely so. He had seen a number of inventions, but none, in his opinion, came up to the one he had described for efficiency. With regard to the fining manufacturers for not consuming the smoke from their furnaces, he agreed with the principle, as he was convinced that they would not take the necessary means for doing so until they were fined.

Mr. FRASER regretted that the able paper which had been read that evening, contained such sweeping condemnation of inventors and inventions; this, he thought, was unnecessary, even in a warm advocate of "large dimensions of boilers" and "slow combustion;" this plan was followed by the Cornish engineers, and in many other instances mentioned by the author of the paper, with success; but this could never become general without replacing a large proportion of the boilers now in use, and in many cases making considerable alterations in the buildings in which they were fixed; the problem to be solved was, how to obtain combustion of smoke with the present boilers and "setting." He was also surprised at the case of hardship which Mr. Muir had attempted to make out for manufacturers, and at the complaint raised against the government for the energetic steps they were taking. The author of the paper thought that no prosecution should be commenced under the act, or fine inflicted, until the government had in each separate case advised with the owner about the dimensions of his boilers, flues, chimney shaft, steam-engine, &c., and then should compel him to adopt the views of their engineers, if unwilling voluntarily to do so. He thought that under the circumstances manufacturers would wish to be "saved from their friend,' and be allowed to burn their fuel and raise their steam in their own way, at the risk of being fined in a nominal amount before the magistrate. The facts of Mr. Muir's paper proved that the requirement of the act had been met, both with and without mechanical contrivances, so that no real case of hardship existed. The Society had been informed that he had applied, at Truman, Hanbury, Buxton, and Company's brewery, mechanical furnaces in 13 different cases, with perfect success, as was confirmed by Professor Brande and Mr. Haywood; and he was prepared to undertake to stoke the largest of them with an area of between 50 and 60 feet, from morning till night, with slack coal, without smoke being seen to issue from the chimney shaft.

Mr. ROY believed that all inventions were useless unless they also paid attention to the quality of coals employed. An experiment had been made lately with anthracite coal, and he had found that the same results might be produced with 8 cwt. of anthracite as with 10½ cwt. of Welsh, showing a great advantage in favour of the anthracite. It had been employed at Whitbread's brewery for the last three or four years with great success. He believed it was economical in use, and entirely did away with the smoke. It was most important that it should be burned with bars about seven-eighths of an inch thick, that there should be ample room for the free circulation of the air. It was a very dear coal, but used in a proper manner it would be found economical.

The CHAIRMAN wished to know what was the price of the anthracite coal, as compared with the Welsh?

Mr. ROY said that he believed it was from 7s. to 10s. a ton dearer, but then it would do thirty per cent. more work; and would, therefore, be equally as economical in use as the common coal. Indeed, he had the previous day seen a furnace which, he was told, with proper attention, would do more work with one pound of anthracite than with two pounds of the common coal.

Mr. D. SHEARS would not trouble the meeting with many observations, after the practical remarks which had been made by some of the gentlemen who had preceded him, more especially by Mr. G. F. Wilson and Mr. Fraser, both of whom, from their great practice and experience, were fully competent to form sound opinions on the subject at issue. Although the Society must feel obliged to Mr. Muir for preparing a paper on a subject of so much interest at this time, yet it could not be denied that there was room for great difference of opinion. He (Mr. Shears), for one, could not refrain from saying that Mr. Muir had been too severe upon engineers and inventors, in his endeavour to refuse them any amount of credit which might be due for having sought to accomplish the desired object by mechanical contrivances. He could not refer to better evidence of the success of such endeavours, than by reference to the testimony of the two gentlemen before alluded to. In the case of Mr. G. F. Wilson, he had, in his capacity of Managing Director of Price's Candle Company, the great advantage of witnessing in daily operation something like thirty large boilers—and boilers all fitted with mechanical furnaces—viz., Hazeldine's and Juckes's—and he (Mr. Shears) could state, from his constant opportunity of seeing them, that the most undeniable success in the consumption or avoidance of all smoke had been accomplished in those works. In the case of Mr. Fraser, he had also very frequent opportunities of seeing and knowing that by the use of some fourteen or sixteen mechanical furnaces, both for boilers and coppers, the chimney-shafts of Messrs. Truman, Hanbury, and Buxton were entirely free from smoke, and he attached much importance to the practical experience of such speakers on this interesting subject. He could not agree with Mr. Muir that mechanical furnaces were unnecessary, for he knew of many instances in which numerous other contrivances had signally failed, admission of air under various conditions having formed the basis of such attempts. He did not appear to have been sufficiently remembered that a variety of circumstances greatly guided the adoption and success of nearly all contrivances for consuming smoke, and he thought it rather hard upon those who had, at so much expense and trouble, complied so entirely with the requirements of the public and the Government, that they should be taunted by the statement that their pains had been unnecessarily bestowed. He (Mr. Shears) knew well, from his own experience,

which had been rather considerable, that smoke could be prevented by careful hand-stoking, in well-constructed furnaces, where the needful attention and care *could be insured;* but the great difficulty was to compel *at all times* the class of men it was usual to employ for such purposes to exercise the required discretion and judgment. He had himself insisted on the smoke being consumed in furnaces under his own guidance, and most perfectly, too. This was nothing more than by careful firing—but then he also knew that the furnaces and boilers were of proper construction, and of sufficient power for the work they had to perform. He would not trouble the meeting further than by stating that however successful might have been in some cases the modes of admitting air as to the consumption of the smoke, yet he could say, from much experience and observation, that in very many cases the adoption of such plans, whether the air was hot or cold, or admitted before or behind, great injury had been occasioned to the boilers, especially where the air was allowed to impinge upon any part of the boiler. But perhaps one of the most important points to be borne in mind during the inquiry was, that some method had to be adopted in many cases which was suitable to *existing boilers and plant*, and this increased the difficulty; for where careful hand-firing might otherwise be made available, as in the case of boilers of full power or capacity, yet in cases where they were but barely equal to the work, it was a subject of serious consideration how the object could be accomplished by mechanical or other contrivances. It would be well, therefore, for those who were compelled to comply with the Act of Parliament under such circumstances, to consider whether greater economy would not be insured by boldly replacing their inadequate boilers by others equal to their requirements, even at some additional first cost.

Mr. Woodcock, Assoc. Inst. C.E., said that he would not detain the meeting by any description of the plans for consuming smoke which he had invented and patented; deeds were better than words, and these inventions were by their perfect success forcing themselves rapidly into notice. It was proved some few weeks back, at the Institution of Civil Engineers, where the speaker had the honour of reading a paper on "The best means of avoiding Smoke from Boiler Furnaces," and during the two evenings' discussion on the subject which followed, that by the use of this apparatus, under an ordinary cylindrical boiler, eight pounds and nine-sixteenths of a pound of water, supplied to the boiler at a heat of 42° Farh., were evaporated by every pound of small Newcastle coal used, and without smoke, thus contrasting most favourably with the capabilities of other furnaces brought under the notice of the Society of Arts this evening. The result was quite equal to any which could be obtained from the use of anthracite coal; and the price of this coal in London being double that of the small Newcastle coal, the question as to the relative value of the two was answered. Mr. Muir need not have fortified any position he assumed on account of the supposed higher authority of Mr. Charles Wye Williams; the latter gentleman had attacked the hot-air theorists (as he termed them) in a most unwarrantable manner, but, perhaps, it would be but generous to let this pass as the heat of argument; it was not right, however, that the principle should be sacrificed, or that Mr. Williams should be quoted as an authority, without the grounds upon which that authority was based being known. It was believed that these rested mainly on his treatise, and after a careful perusal of this work it would be incorrect to state that it did not contain much valuable matter, but it must be clear to every one that the conclusions were drawn first, and facts were afterwards cleverly compelled to fit these conclusions; almost every page of the book gave this impression, and an investigation of a French work, published some thirty or forty years since, by Mons. Péclet, "Traité de le Chaleur," would show that the bulk of the arguments were drawn from that source, but with the remarkable difference that M. Péclet argued for the use of hot air, Mr. Williams for cold. An inquiry into the origin of the use of his perforated plate would also show that it was much older than his patent, it having been in use in London for the last thirty years. This was proved at the Institution of Civil Engineers on the 14th November last. These facts would give the real state of the case as to Mr. Williams's book, and his patent also. It had been affirmed positively that smoke once made could not be consumed in the same furnace. Now his own furnace could at will be seen to be full of true smoke, such smoke being purposely formed, and being the result of imperfect flame, and yet without a particle of that smoke appearing at the top of the shaft. If it was not burned, what became of it? Nevertheless, the most consistent part of Mr. Williams's work appeared to be the conclusion arrived at that smoke could not be burned, seeing that he had never used the proper means, "heated air;", and, therefore, his experience furnished no instance of this desirable end being accomplished. Mr. Muir had challenged the London smoke-burners to produce a furnace which would make less smoke than an ordinary kitchen chimney. That challenge was gladly accepted, and a furnace could be found which, during a month's work, would not emit from the shaft a tenth part of this quantity.

Mr. Wilson, of Millwall, wished to put a question to Mr. Muir, relative to the proper dimensions of furnaces. He was a small manufacturer, and had great difficulty in applying any mechanical invention to his furnaces. He had been speaking that day to a gentleman who had two mills, and who had great difficulty in the application of mechanical inventions, from the necessity of keeping his works going night and day. He knew that with the majority of inventions the works would occasionally require being looked to, and what he desired to be informed was the area of the furnaces used by Messrs. Walker, of Salford, who, Mr. Muir had explained, consumed their smoke without the aid of mechanical appliances.

Mr. Muir was not aware, but he was sure, if Mr. Wilson would write a letter to Mr. Bury, the manager of Messrs. Walkers' works, that gentleman would give him every information on the subject.

Mr. Wilson thought that a most important question to small manufacturers was, what furnace space was required to get rid of the smoke without mechanical appliances. There were a large majority of manufacturers who only possessed one boiler; he himself had two, and they could not keep up their steam at all times if they were liable to derangement in the machinery.

Mr. Lee Stevens believed he could in some measure answer the last observation. One of his furnaces had been in operation day and night for twele months, at Messrs. Marshall's, of Leeds, without requiring the slightest repair. Mr. William Marshall, after one of the furnaces had been up six months, had an opportunity of examining it, and found there was not the slightest oxidization in the boiler-plates.

The Chairman regretted that their time was so limited; but he must now draw the discussion to a close. It appeared to him that the subject before them was one of great importance, as upon it depended whether the manufacturers could comply with the Act for the Consumption of Smoke, and how they could best do so. He did not expect that he could add much to the valuable discussion they had heard, but he was of opinion that nothing could so effectually meet the requirements of the case as ample room in the furnace, large boiler space, and slow combustion; for, wherever a fire required to be constantly fed there was sure to be an increased expenditure of fuel, and a great quantity of smoke. Indeed the combustion should be as slow as practised in Cornwall, where they only feed their fires once an hour, and very little smoke was produced. They had there the advantage of burning Welsh coal and complete supervision of their furnaces. The same results might be obtained by the use of anthracite. But wherever they had an active combustion and limited boiler space, mechanical aids were required to destroy the smoke. Then, as regarded locomotive engines, the steam, ascending, drew

up a large quantity of atmospheric air through the fire, and caused most active combustion, and consequent smoke. He believed that if the nuisance could not be wholly put an end to, it might be mitigated to a considerable extent. It had been got rid of to a very great extent in Manchester, for though the number of engines at work had been doubled within the last fifteen years, the quantity of smoke was not more now than at the commencement of that period; and this had been accomplished by the authorities instituting proceedings against offenders. He did not agree with the opinion of Mr. Muir that the Government were not justified in imposing fines on the manufacturers for causing smoke, for he believed they would never get rid of the nuisance without some stringent measures. He was of opinion that, without fines or penalties of some kind, the manufacturers would not take the trouble of seeing how the smoke was to be got rid of, or compelling their managers to do it. He was satisfied there was not an engineer in the country but who would most willingly lend a helping hand to abate the nuisance, and thus purify the atmosphere of large towns, and improve the health of the community. A frend of his calculated, but he (Mr. Fairbairn) did not vouch for the fact, that in Manchester £200,000 a year could be saved in soap alone by doing away with the smoke. He saw by the papers that in the metropolis Lord Palmerston's Act was being carried out through the exertions of the police, and one manufacturer, on being fined £5, was told by the presiding magistrate that if the nuisance was not abated, he would, on the second information, be fined £10, for the third offence £20, and so on, in arithmetical progression until the fines amounted to sufficient to pay off the National Debt. He (Mr. Fairbairn) would encourage all inventors. He believed that great merit was due to them for the manner in which they had improved the combustion of smoke, and it showed that active spirits were at work to obviate the nuisance which was so generally complained of. He had now only to propose, and he was sure they would all most cordially join him in it, that the thanks of the Society be voted to Mr. Muir for his very interesting and instructive paper.

Mr. Muir thanked the company for the manner in which his paper had been received, and claimed their indulgence for a few minutes to reply to the observations made, it upon no other ground, than upon that of his having travelled 400 miles in order to have the honour of appearing before that Society. With regard to the economy of Hazeldine's furnace, it appeared that it evaporated 6·88 lbs. of water to 1 lb. of coal, whilst from the experiments of Professor Playfair and Sir H. De la Beche, made for the Royal Navy, with an ordinary furnace stoked by hand, the rate of evaporation was found to run from 6½ to 10½ lbs. of water evaporated to 1 lb. of coal. The testimony with regard to the evaporation was not such, therefore, as to induce him to lay any great stress upon it. A great deal had been said about the consumption of slack or refuse coal. In Glasgow, with very few exceptions, nothing else was used. In some cases large coal was used because the manufacturers thought it advantageous, and in others, because they could not obtain a sufficient supply of slack, but the use of slack was the general rule. It was not right, therefore, to give any particular credit to Hazeldine's, Juckes's, or other inventions for the use of slack. He would not say anything with regard to brewers' coppers, because there might be some peculiarity in their construction, and after all, they would only stand as 1 to 1000 of other furnaces; but he had seen a brewer's copper, fired in the ordinary way, make very little smoke indeed. He wished to know whether Ford had renewed his patent for 6 years.

Mr. Maudslay.—Yes.

Mr. Muir had asked the question because he had mentioned the furnaces as Godson's, having been informed that Ford had sold the patent to Mr. Godson, of 72, Aldersgate-street. He had seen it, and thought it very good for small furnaces; it was the same as Dr. Arnott's domestic fire-place. There was likewise the model of a furnace, under the same construction, on the table, marked as Coupland's. He had not meant to say, as Mr. Maudslay seemed to think he had, that manufacturers ought not to be fined if they refused to adopt means for the consumption of smoke. He only differed as to the time at which compulsion should be exercised. But they could not expect the manufacturers voluntarily to adopt any system for the consumption of smoke until they were shown that it would be ultimately successful in effecting the object they had in view. He wished to know whether Mr. Shears was the proprietor of Hazeldine's furnace?

Mr. Shears replied that he was not, though it was a party of the same name, but unconnected with his establishment.

Mr. Muir said that a gentleman from Scotland came up to town and went to Mr. Shears, naturally expecting to find Hazeldine's furnace in operation. He did not, however, and Mr. Shears expressed his opinion that Juckes's, Ford's, and other furnaces might do very well, but that the smoke might be equally well got rid of without machinery and without expense. Mr. Stevens might not recollect it, but he (Mr. Muir) spent two forenoons, about eighteen months since, in inspecting his furnaces. He had no doubt that the admission of air through the split bridge (which was Mr. Stevens's patent) was advantageous when there was sufficient draft and proper attention. He first went with Mr. Stevens to some place near St. Paul's, where he saw there was a good draught, and there little was or no smoke. He next proceeded to Messrs. Miller, Ravenhill and Co., and there he saw a large quantity of smoke, which was explained by its being stated that the men had not properly attended to the firing. This he had seen happen in a hundred cases; and all he could say was, that if the master was at the cost of a good system, and the man who was employed to do so did not attend to it, then fine him. He was aware that Juckes's furnace was successful in some places, but it had failed where he had been the means of introducing it. He was instrumental in having it adopted at Messrs. Crums' Calico Works, Thornliebank, near Glasgow, and he obtained a certificate from them that the consumption of coals was two and a half tons a day. Being, from what occurred afterwards, doubtful of the correctness of this, he measured the furnace. He calculated the quantity consumed per day, and he discovered that they were consuming 3½ tons of coal instead of 2. They afterwards became displeased with Juckes's furnace, and when he called one day he found they were about to send a portion of it to the melting pot. He, however, persuaded them not to do so, as it answered in London; it would injure the inventor, and he would try to sell it. They gave him a month to do so; he wrote to a number of firms using Juckes's furnaces, offering it at a considerable reduction in price, but it still remained unsold. There were also three other of those furnaces which cost £500, and which any gentleman might have at a very reduced rate. They had heard that night something of the advantages of anthracite, but he had been told that Mr. Bodkin, Lord Palmerston's counsel, insisted in one case on a person being fined for using coke and anthracite mixed. Mr. Bodkin had also insisted that every furnace should be supplied with a smoke-consuming apparatus; but had his arguments been opposed by counsel of equal eminence and ability as Mr. Bodkin, he was sure no magistrate could have given a decision in his favour. He did not wish to drive a coach and six through the Act of Parliament, but the convictions under the act were a mere sham—a sham which might soon be put an end to, and an efficient act obtained in its place. He was satisfied that neither the public nor the manufacturers could properly carry out the act until they had the means given them of determining which was the best system of consuming the smoke according to the circumstances of each case. He would refer to the observations of Mr. Fraser,

to say that he had seen Juckes's furnace in operation at Messrs. Truman's. He did not deny that it answered very well there, but it failed in the manufactory where he had recommended its trial, and the result was a loss of £500 to the manufacturer. These facts proved that it was a very difficult matter for a manufacturer to choose from among the many plans.

The CHAIRMAN had been informed by the Secretary to the Commission for the Board of Health that the returns from the furnaces where they consumed their own smoke debited the owners with an average saving of 17 per cent. in their fuel.

A GENTLEMAN complained that the government establishments at Woolwich and Greenwich were the largest smoke-makers in the kingdom, and that no attempts appeared to be made to abate the nuisance there, where the Government had the whole thing at their command.

The Secretary stated that the drawings and models of inventions for suppressing the Smoke-Nuisance, which were then exhibited, would remain on view during the remainder of the week.

He then announced that the Paper to be read at the next meeting, Wednesday, January 24th, was "On Peat and other Vegetable Charcoal, and some of its Uses," by Mr. W. Longmaid.

Also, that the following arrangements had been made for succeeding meetings:—

Jan. 31. Mr. S. C. Homersham, "On the Chalk Strata considered as a Source for the Supply of Water to the Metropolis."

Feb. 7. Mr. Thomas Dickins, "The Commercial Consideration of the Silk-worm and its Products."

Feb. 14. Mr. J. A. Franklin, "On the expediency of at once Decimalizing English Moneys and Weights."

Feb. 21. There will be NO MEETING, it being Ash-Wednesday.

Feb. 28. Professor John Wilson, F.R.S.E., "On the Iron Industry of the United States."

March 7. Mr. J. B. Lawes, "On the Sewage of London; its Composition and Value as a Fertiliser."

Also, that on the evening of *Friday*, the 2nd of February, there would be a Special Meeting to consider the proposed European Congress at Paris, as to the Improvement of International Commercial Law.

Home Correspondence.

SUGGESTIONS ON NEW MATERIALS FOR COMMERCE.

SIR,—The following remarks and observations on the paper I read before the members of the Society of Arts on the 29th November, coming as they do from a thoroughly practical man—Captain Messum, one who has had great experience as a trader—are so important that I cannot do better than submit them for the consideration of the members, under the constant desire of aiding, as far as possible, the extension of our range of commercial operations.

Your obedient servant,
P. L. SIMMONDS.

5, Barge-yard, City, Jan. 8, 1855.

Liverpool, Jan 7, 1855.

DEAR MR. SIMMONDS,—I have just been quietly reading your very valuable paper, read before the Society of Arts in November, and I know you will pardon the following remarks, which have practically come to my knowledge:—

First, as to ROOTS.—The Kaffir potato is indigenous to the north-east part of the Cape Colony, something resembling the red kidneys of England, but much smaller. This, I presume, could be somewhat remedied by better cultivation; but what the root does not produce in size it does in quality—the taste is excellent, and they are preferred to those grown from imported seed. There is a large tuberous root, something resembling the Cassava in shape, but the plant grows similar to the Manioc. It is not cultivated, but the Hottentots feed readily on it. Throughout the whole desert of Namaqua Land there grows a small bulbous root (Orchis); these are roasted by the natives, and form at seasons their principal food;—they taste like roasted chestnuts. Arrowroot grows better in Natal than any place I have seen it. The most palatable root, and most profitable I know of, is the *Taro* or *Turah* of the South Sea Islands. It grows something like the beet-root: the top, or greens, is made into a famous dish by the natives, called Poi, or Pollie-Samoie. I have found the root keep good on board ship longer than two months.

FIBRE-COIR.—English shipmasters have a great antipathy to rope manufactured from this material, but those who have been in the country ships in India prefer it to European hemp for every purpose, except the roping to the sails, and some minor purposes. The large sizes made for standing rigging in India are good, and when once thoroughly stretched, do not contract and expand with wet and heat so much as hemp; the small-size rope manufactured in India is laid up too hard, and should be three-strand instead of four. The best coir-rope manufactured is by the natives of the Fejee and Friendly Islands—each yarn is three-plait. A gang of mizen rigging made from this rope had lasted eight years when I left the vessel, and was perfectly good. It may be in the vessel yet, for aught I know. Madagascar has been entirely overlooked by you as to fibres. Mauritius has received annually from thence 80,000 to 100,000 rattanas. These are about five feet square, of a coarse but good manufacture, something like sacking, but much stronger, made of fibre very long in the staple, and certainly equal to the best Russian hemp. They are principally used to dry the sugar on—each one contains about one hundredweight. The raw material from which this article is manufactured is most valuable. The sugar-bags made by the Kaffirs, at Compensation, Natal, for Mr. E. Morewood, were made of a fine strong plant, far superior to the Vacoua bags of Mauritius—it has a long fleecy fibre, well worthy of attention.

GUMS.—I have long had my attention directed to this article, and should wish to have some practical knowledge of the different descriptions. It is generally known that South Eastern Africa abounds in gum; from the Mimosa, in Natal and Kaffraria, thousands of tons could be collected, but those who have engaged in it say it will not pay to gather at 2½d. per pound. You have a great difficulty in getting the natives to collect it. When surveying the West Coast we found several different kinds of gum, and specimens were sent to Hull, but I have never seen a report on them. I believe, between Angra Pequina and Port Alexander, there is Gum Benzoin or Benjamin, and Gum Anime. A gum contained in the pith or centre of a plant grows about three feet high. This same plant has a gum of a different description coming from the branches; and others, that I have lost recollection of, unless referring to my journal of that date. North of Port Alexander, and through all Benguela, quantities of ochilla weed are obtained on the coast, and gum copal from some short distance inland.

GUTTA PERCHA.—I saw before leaving Mauritius samples of excellent quality brought from Madagascar. In

Natal the tree grows in all the sheltered valleys bordering on the sea coast. Natal is the country for all species of Euphorbia. Here you see this magnificent tree towering above 60 or 80 feet, looking down with contempt on its surrounding neighbours; if these are valuable, any quantity could be obtained. I am not acquainted with the exact plan used in India for puncturing the tree.

TIMBER.—I only have to make a few observations on the timber of Southern Africa. The Cape Colony is thought to be very deficient in this material, but in the district of George, the most magnificent forests exist. The Zitzikamma forest, extending from Plattenbergs Bay to the River Zitzikamma, is as little known as the centre of Africa, a distance of about 60 miles from W. to E., and 30 from N. to S. Here the elephant, buffalo, and larger game rove undisturbed by man. The giant of the forest is the *Yellow Wood*, a close-grained, light-coloured wood, durable for building purposes; it makes good furniture, and when polished in appearance equals satin-wood; it is very durable under water. (I used, at the Knysna, to repair my bulwark, the bottom of a punt that had been under water twenty years; it was perfectly sound). It makes good staves for ordinary casks, is always used for butter casks, as it has no resinous smell, and makes good deck planking for tropical climates. I have seen them grow without a branch 60 feet. *Stink Wood*, hard and very durable, but rather difficult to work, is used for furniture, takes a very high polish, and makes splendid gun-stocks. A great quantity is used by the navy in Simon's bay; they contract annually for about 600 loads. It is good for ship-building—capital outside planking above water. There is also Assigie, used for spokes, axles, and felloes of waggons. Red-milk wood, suitable for the same purposes; white milk wood, "iron wood," white alse, red alse, all used about the different parts of a Cape waggon, which is something like a donkey, never known to die a natural death; all the latter make excellent crooked timber for ship-building.

SWEEETMEATS AND JELLIES.—You have never tasted Matingalo jam! then you have never tasted the best preserve made at Natal. I think this fruit would grow in England, and improve by cultivation. Four years ago I took some slips to Mauritius, in February last they were thriving well; I had some fruit, and Mr. Duncan, the Curator of the Botanical Gardens, gave me his opinion as above. At Mauritius, they preserve a great quantity of fruits. I have exported from thence pine apples, preserved whole, in tins, containing syrup; mangoes, leches, and other fruits preserved in the same way, with jellies and marmalades. They have a large manufactory at the Fleur Mauricienne.

FISHERIES—The Cape exports annually to the Mauritius about 2,500 tons of fish, which is about three-fourths the consumption of the island; the remainder they obtain from their dependencies, principally Rodriguez, some small quantities from the Persian Gulf, and an occasional cargo from North America; the principal consumers are the Indian population. Guilbach, or Cape Salmon, is the first as to quantity; they are all taken with hook and line, and weigh about 14 lb. The cost of production ready for shipment, is about £12 per ton; the Malays at the Cape cure a great deal in vinegar (for home consumption), the same as pickled salmon in England; and it is not a bad representation of it. For exportation they are opened down the back, the intestines taken out, head cut off, salted for a night, and dried in the sun.

Snook, similar to the baracouta, is a long, slim, oily fish, taken with any shining bait; it is a perfect salt water pike; these are cured the same way as the guilbach; the cost of production for exportation is about £16 per ton; they are esteemed before any fish imported into Mauritius, fetching about £2 per ton more than cod; these fish are fine eating, whether cured or fresh; the Malays cure them without salt, by drying in the sun with a little pepper and spice; they are then delicious.

Silver fish, similar to the bream of England, each weigh from six to eight pounds; they are got up for exportation, the same as the others; the cost of production is about £10 per ton; they are least esteemed of any at the Mauritius market, but when fresh they are very nice eating.

Harders are a mullet, about eight inches long; they are principally cured in small casks, in brine, for up-country use; the farmers are very fond of them, but few are exported. They have also mackarel, very large, very fat, better cured than fresh. Roman and white fish are very excellent.

Sardines in myriads swarm round the bay at one season of the year; klip fish, king klip fish, and soles rather scarce—considered a luxury.

Thousands of cray fish are caught daily; four of the largest can be obtained for one penny, but it is not fashionable to eat them; notwithstanding which they are very good. The value of the fish exported from the Cape may be estimated at £25,000; this, with other productions, pays for the sugar consumed, and leaves a balance in favour of the Cape. The quantity could be increased almost *ad infinitum*, were a market found. I question if the cost of production could be lowered; salt, labour, and packages form considerable items in dried fish; but sardines in the French style, potted cray fish in the American, and the choicest fish preserved fresh in tins, might be made profitable. The quantity of fish throughout the whole extent of the coast bordering on the Lagulha's Bank is immense, and would be the richest fishery in the world. I think it probable that some of the fish of Southern Africa may have a swimming bladder suitable for making isinglass. I should wish to know the kind required and the mode of operation, and I am confident of being able to send to England a sample next year—of what quality, remains to be proved.

Of sharks perhaps the West Coast of Africa is the most prolific, both in variety and quantity. All the fat or oily matter is contained in the liver, which is nearly all oil. The one you speak of on the American coast, the liver filling ten barrels, is probably an error; the largest species of shark is known as the Bone shark. It has a very large mouth, no teeth, but a hard bony gum. In 1848, when at Ichaboe, I harpooned one of these monsters, (recollect I had been six years whaling in the Pacific, considered myself an expert hand, and was provided with good whale-boat, crew, lines, lances, and harpoons) about noon, and was fast for full six hours before I slew it; the difficulty in killing it was, it was not compelled, like the Mammalia, to come to the surface for air, but stuck as near the bottom as possible in ten fathoms of water. When we did succeed in getting it to the surface, as soon as it felt the prick of the lance, it darted off, carrying the boat after it at the rate of ten or twelve miles an hour; however, it was eventually killed, and we attempted to hoist it on board the ship, but a luff tackle fall, rove of 3-inch rope, parted, and we had to tow it on shore to the Island of Ichaboe at high-water. When the tide fell it was high and dry; it measured in extreme length 32 feet; its jaw went over the head of a 180 gallon cask, when it was dried. The liver, when cut up in slices, filled two tierces and a tub (about 80 gallons in all), it made 48 gallons of clear pure oil, besides about ten gallons of thick and inferior. Our method of boiling it was very imperfect. I think the whole fish may have weighed three tons.

EGGS.—I note the hint you have thrown out on sea-bird's eggs; could you get information as to how they must be imported to be useful in the manufactories. I could supply certainly fifty tons per annum, if their being packed in salt and in barrels would do. Of alligators, are you aware that oil of a fine quality is procured from them, considered most valuable for scalds, burns, and rheumatism; they are the perfect pests of the rivers of Natal; the skins are generally thrown away. The hippopotamus is found in all the rivers and lakes; it yields an immense quantity of fat, equal to the finest butter; its flesh is excellent, and equal to bacon when cured the same way; its skin as yet has been only used, locally, for whips or sjamboks. What would be its value in England?

The cowrie shell, similar to those used in India, is found on the coast of Natal. Large quantities of pearl shells were exported from Algoa Bay, but always resulted in a loss. It has almost ceased to be an article of exportation. Considerable quantities of the real pearl oyster may be obtained throughout the whole of the Friendly and Fejee Islands. At Savage Island the beach was covered with them; Madagascar will be a very likely place, as beautiful specimens of shells come from there.

JERKED BEEF, HIDES, AND TALLOW.—I know of no place so well situated for this commerce as Walwich Bay, on the west coast of Africa; although the country adjacent is a perfect desert, yet in the valley of the Swacup nutriment sufficient for 1,000 head of cattle may be found. This is the best outlet—perhaps the only one—for all the country of the Namaquas north of the Orange River. East of the Great Lake and the country explored by Dr. Livingston, and north of the country of the Damarez, is rich in cattle; the climate is so drying that I have kept beef a month without a particle of salt; all the juices are dried up by the atmosphere. Here a curing establishment might be established, with a good boiling apparatus. Fuel would have to be brought. The hides could be salted, the fleshy parts jerked, and all the remainder boiled down, except the horns and hoofs. By trading with the natives, oxen may be bought at about 7s. 6d. per head. We used to get three for a musket. Port Alexander is also a good place. Ivory may be obtained here, as well as bees-wax, skins, and ostrich feathers. Many thousands of pounds of feathers could be obtained at the rookeries of the different sea-birds on the islands of the Southern Ocean, but there is a difficulty in getting rid of the fishy smell they have.

SEAWEED.—In a space of sea contained between the Gulf-stream, Madeira, 25° north latitude, and the tropic, is the Sargossa Sea—named from immense fields of weed known by that name. Any quantity could be obtained. Is not this the same weed that is burned into barilla—at the Western Islands, Madeira, &c.—if so, could it not be as easily burned in Britain, after being imported in its raw state?

Should any of the foregoing suggestions be of any interest, you can make what use you please of the information, and my name for the authenticity.

Yours faithfully,
WILLIAM MESSUM.

LIQUID MANURE.

SIR,—The following notes of a lecture, given by Mr. Wilkins, at the London Tavern, on Thursday evening last, may be interesting to some of your readers, the subject being the application of liquid manure to the roots of plants.

Mr. Mechi (who presided), in introducing the lecturer, stated that he had, with two or three other gentlemen, seen some experiments at Reading, the result of which was most extraordinary. Mr. Wilkins had there taken some very poor land, near the station, and divided it into a series of double beds, for various kinds of produce, one bed being treated by Mr. Wilkins's process, and the other adjacent to it by the ordinary method; in every instance the produce of the former largely exceeded that of the latter, the seed being sown in both beds at the same time, and from the same parcel. It was a matter of calculation, whether the produce would give a sufficiently large return to justify so great an outlay, but he thought that if the cost of paving, &c., were even £100 per acre, it was a question whether the increased crop would not return an ample interest on the outlay and a large profit. All the crops on the beds at Reading, treated according to Mr. Wilkins's process, exhibited extreme freshness and luxuriance, and especially, in the case of the mangold-wurzel and carrots, great freedom from fangs. The practical application of the sewage of our towns to the land by means of pumps and pipes, as he distributed liquid manure at Tiptree Hall, was a subject deserving great attention. Prof. Way had estimated the value of the sewage of London at two millions sterling; it would be a very great result if it could be disposed of even for one million. The water companies pump up and convey a ton of water several miles for about a penny, and if it can pay to bring the water for London from Hampton, it would, he thought, be quite as economical to pump out the sewage of London to the waste lands and heaths in the neighbourhood, and, by making sterile land productive, largely increase the food of the population. By applying manure as a top-dressing, the surface was to a certain extent caked or hardened, but in Mr. Wilkin's system the top soil remained uncaked, and absorbed freely the rays of the sun.

Mr. Wilkins commenced by stating that by his improved system of agriculture, Russia would be superseded in the growth of hemp and flax, and England would be independent of all nations for the necessaries of life; that two crops, nay, three crops, and for cattle seven crops, annually might be produced.

In the year 1853 the lecturer took a piece of waste land at Wokingham, adjacent to Mr. Walter's property, which he laid out and planted with flax and hemp, according to his own method, as follows:—The upper soil being removed, a paved floor of brick was constructed, at about 18 inches from the surface, round which was placed brick on edge 4½ inches high, forming a raised rim round the entire plot, the whole being made perfectly watertight; semicircular tiles with open joints were placed longitudinally on this floor, having their convex side upwards and communicating at one end with a vertical pipe, to receive the liquid manure, and at the other with a plug, by raising which the quantity of sewage water, in the bed could be reduced or entirely drained off; there was also another pipe by which could be observed the height at which the fluid stood in the bed. The rows of drain pipes were laid parallel to each other, their distance apart being regulated by the width between the rows of seeds about to be sown.

The top soil was then replaced to a level with the surface, and the flax and hemp sown in rows exactly over the line of drain pipes; the liquid manure was applied down the pipe once or twice a week, allowed to stand a short time in the bed, and then drained off. The first crop of hemp was sown in the middle of April, and the second crop, from new seed, three months after, on the same ground; both crops were about six feet long. Specimens of these were produced, as also of the two crops of flax grown on the same land.

Mr. Wilkins considered that the application of liquid manure to the root of a plant was the true principle of nature; that the tip of the root was the mouth of the plant, the leaves were its lungs, and that, in order to render that plant luxuriant, its food must be supplied to its mouth, and not to its lungs. He did this by his method, the liquid being drawn up by capillary attraction and evaporation, to the roots.

The lecturer then exhibited some specimens of potatoes, mangold-wurzel, Indian corn, beetroot, Italian rye-grass, and Lucerne, produced on the experimental garden at Reading, laid out on the principle as before described. The rent paid by him for this piece of ground (seven acres and a small cottage) was £2 per annum. The plants in each double bed were sown on the same day from the same seed. These beds were each 100 feet square, those on the new principle receiving about two feeds of liquid manure weekly, and no manure being applied to the adjacent one. The result of the experiment was that on the beds cultivated on his system the potatoes were double the weight of those on the unprepared piece, being taken up in eleven weeks. The mangold-wurzel was produced at the rate of about sixty-nine tons per acre, the average weight of the roots being twelve pounds each, whereas on the unprepared piece it was four pounds, and on a piece of ground prepared with a top dressing of liquid manure, six pounds. The Italian rye-grass was cut

five times on the prepared bed to one cut on the other; the fifth of the former being exceedingly tender and juicy, while the one of the latter was tough and dry. The Lucerne also gave three cuts on the new system to one on the old. The Indian corn came to a good-sized ear on one piece, but no corn ripened on the other. The wheat and Swede crop did not succeed, owing, as Mr. Wilkins supposes, to bad seed. The white turnips were sown on September 2nd; on one bed turnips of a large size were produced, on the other the seeds never vegetated. After the potatoes were taken up on the prepared bed winter broccoli was sown, and in six weeks was ready for table. This was followed by Savoy cabbages, fit to cut last month, or three crops produced between May and December. A cattle cabbage was grown weighing twelve pounds; its stump was allowed to remain on the ground, and it had now on it fifteen young cabbages. In June he had planted a small potato, picked up at Wokingham, of a kind which but seldom arrives at a large size; this was taken up early in September, in the presence of Mr. Mechi, when the haulm was found to be five feet long, and the produce of the root seventeen potatoes; having a total weight of 8½ pounds, one potato alone weighing two pounds.

An ash-leafed kidney, planted in sand, on the top of a house, in eleven weeks produced eighty-four potatoes.

The results of feeding cows on the rye-grass produced, was that one cow gave seven quarts of milk when fed on the grass from the bed on the new system, but only six quarts when fed on that from the other. The lecturer had no doubt that the cream and butter would be largely increased. It was mentioned that the application of sewer water to the roots of some geraniums had caused them to be in perpetual bloom, and suggestions were thrown out for the application of this principle to conservatories and sitting-rooms.

Mr. Wilkins estimated that the cost, according to his present construction, with bricks or tiles, would be about £100 per acre; but he believed, by forming the water-tight bottom of gas tar and sand, that the expense would be reduced to about £50 per acre. Even at the larger cost, on the very worst land, he was certain a very large profit would accrue, and that, by the employment of his principle, England might become independent of all nations for the necessaries of life.

I think that this method is peculiarly applicable to cottage gardens, where it will no doubt largely increase the crop; but it appears to me that the difficulties in carrying it out on a large scale will be very great, though I do not say they may not be overcome by talent and energy.

If executed in a series of small beds, the cost of distribution would be excessive. This is a point upon which Mr. Wilkins has not entered, and which would be insignificant in an experiment on a small scale. If, on the other hand, the beds or reservoirs are constructed of large area, the ordinary drainage of the land will not be so efficiently carried on; it would be difficult to keep the reservoir perfectly water-tight; and in undulating ground the sewer water would not be retained in the reservoir, but drain off over the lower edge.

I therefore do not think that the construction adopted by Mr. Wilkins will be likely to succeed, though I am of opinion that the system may, in time, be brought into profitable use on a large scale, by some modification of the present draining tiles and mode of laying them, so as to combine in one operation the two objects of surface-drainage and underground application of liquid manure.

The subject could not be in more able hands than those of Mr. Mechi, who will, I have no doubt, give it a fair trial on a large scale, and express his valuable opinion thereon. I hope before the end of another year we may have this and other information connected therewith, and thus be enabled to come to a conclusive decision on this important subject.

H. P. STEPHENSON.

London, 37, Charing-cross, January 15th, 1855.

Proceedings of Institutions.

CROYDON.—Strenuous exertions have lately been made, by the friends and members of the Literary and Scientific Institution, to enlarge its sphere of usefulness. The management has been entrusted to gentlemen of energy and perseverance, and it is hoped that with the support of the public, the Institution will be rendered worthy of this large and populous town. The first lecture of the winter quarter, was given by Mr. Henry Phillips, "On the City of the Sultan;" it was very fully attended, and gave universal satisfaction. Mr. Phillips will shortly be followed by Mrs. Balfour, on "Memorable Youthful Poets," and by Mr. George Dawson, on "Alfred the Great." This Institution has just agreed to a General Interchange of Privileges with the other Institutions in Union.

To Correspondents.

ERRATA IN REPORT ON TRADES WHICH INJURE THE EYES.—Page 123, col. 1, third line, 2nd par of small type, for *smoker* read *worker*; page 123, col. 2, line 31, for *fine* parts read *fore* parts; and page 123, bottom of 2nd col., and page 124, top of 1st column, for *pinkers, pinker,* and *pinked,* read *prickers, pricker, and pricked.*

The Honorary Secretary to the Stockton-on-Tees Mechanics' Institute writes to say that so far from there having been an *entire absence* of officials at Mr. G. S. Phillips's lecture "On the Poetry of the Pope Era," as mentioned in the Journal of the 29th ult., *six* of the Committee and *one* of the Secretaries attended. The notice in question was obtained from an extract from a local print enclosed to the Secretary.

MEETINGS FOR THE ENSUING WEEK.

MON. Architects, 8. Mr. T. L. Donaldson, "On Some of the Constructions now in course of Erection between the Louvre and the Palais Royal at Paris."
Entomological, 8. Anniversary.
Geographical, 8½. 1. Mr. Keith E. Abbott, "Geographical Notes taken during a Journey performed in Persia." 2nd. series. 2. Lieut. R. Burton, "Proposed Expedition to the Zomali Country in Eastern Africa."

TUES. Royal Inst., 3. Professor Tyndall, "On Magnetism."
Meteorological, 7. 1. Dr. Buist, "On the Means of Determining the Amount of Evaporation from the Earth's Surface." 2. Mr. Doggett, "On the Weather in Connection with the Growth of Barley."
Civil Engineers, 8. Mr. J. Brunlees, "The Sea Embankments in Morecambe Bay; Ulverstone and Lancashire Railway."
Med. and Chirurgical, 8½.
Zoological, 9.

WED. Royal Soc. Literature, 4½.
Society of Arts, 8. Mr. W. Longmaid, "On Peat and other Vegetable Charcoal, and Some of its Uses."
Microscopical, 8.

THURS. Royal Inst., 3. Mr. W. B. Donne, "On English Literature."
Numismatic, 7.
Antiquaries, 8.
Royal, 8½.

FRI. Philological, 8.
Royal Inst., 8½. Professor Tyndall, "On the Nature of the Force by which Bodies are Repelled from the Poles of a Magnet."

SAT. Royal Inst, 3. Dr. J. H. Gladstone, "On the Principles of Chemistry."
Royal Botanic, 3½.
Medical, 8.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Jan. 12th,* 1855.]

Dated 16th December, 1854.

2656. D. D. Deming, New York—Machine for cutting cloth, &c.

Dated 22nd December, 1854.

2701. L. J. F. Margueritte, Paris—Caustic and carbonated potash and soda.
2703. A. Suter, 65, Fenchurch-street—Wind guard.
2705. F. Prince, Haverstock-hill—Nipples of fire-arms.
2707. E. Loysell, Paris—New game.
2709. J. Downie, Glasgow—Fire-arms.
2711. A. E. L. Bellford, 16, Castle-street, Holborn—Breech-loading fire-arms. (A communication.)

Dated 23rd December, 1854.

2713. J. Walker, Wolverhampton—Bricks, tiles, pipes, &c.
2715. G. Anderson, Rotherhithe—Purifying sewers and buildings.

Dated 26th December, 1854.

2720. A. Dormoy, Seuillon, near Langres—Iron shovels.
2721. C. E. White, Fulham, and F. Robinson, Putney—Railway signals.
2722. B. Bishop and J. Dyer, Birmingham—Hinges.
2724. F. S. Thomas, Fulham, and W. E. Tilley, 6, Kirby-street, Holborn—Plating metals with tin, nickel, or alumina.

Dated 27th December, 1854.

2725. J. Dundas. Dundas Castle, Linlithgow—Ordnance.
2726. J. Nash, Market Rasen—Drying malt, grain, or roots.
2727. G. Carter, 42, Lombard-street, and H. C. Symons, 52, Castle-street, Southwark—Boilers and furnaces.
2728. T. Boyle, 45, Skinner-street, Snow-hill—Reflectors for artificial light.
2729. J. L. Dunn, Glasgow—Useful products from waste sulphates and nitrates.
2730. W. E. Newton, 66, Chancery-lane—Looms. (A communication.)
2731. J. Comstock, New London, U.S.—Trip hammers.
2732. Lord Berriedale, 17, Hill-street—Washing cloth or yarns.
2733. J. Cumming, Glasgow—Ornamental fabrics.

Dated 28th December, 1854.

2734. C. May, Great George-street—Screws.
2736. J. Cockcroft, New Accrington—Printing textile fabrics.
2740. W. Ward, Sheffield—Stoves.

Dated 30th December, 1854.

2754. C. Bissell, Birmingham—Sights for rifles.
2756. E. Mayeur, 62, Tredegar-square—Centrifugal pump. (A communication.)
2760. R. S. North, Gorton, near Manchester—Railway switches and crossings.
2762. J. H. Johnson, 47, Lincoln's-inn-fields—Motive power. (A communication.)

Dated 1st January, 1855.

2. W. W. Lewis, Hanley-castle—Charcoal.
4. G. Crane and I. J. Crane, Chester—Coating for ships' bottoms.

Dated 2nd January, 1855.

6. B. Britten, Anerley—Obtaining a copy of writings, drawings, or tracings in ink.
8. H. L. Dormoy, Paris—Twisting silk and other fibrous substances. (A communication.)
10. C. J. Fincken, Paris—Preserving windows, &c., from condensation and damp, and from smoke, soot, and dust.

WEEKLY LIST OF PATENTS SEALED.

Sealed January 12th, 1855.

1531. William Armand Gilbee, 4, South-street, Finsbury—Improvements in the application to weaving of certain textile plants not hitherto employed, either alone or in combination with silk, cotton, and other fibrous substances.
1537. Thomas Bennett Foulkes, Chester—Improvements in the manufacture of self-adjusting gloves.
1541. John Hackett, Derby—Method of fastening the ends of india-rubber elastic cord and india-rubber elastic web.
1559. John Ashworth, Turton—Improvements in apparatus to be employed in the construction of the permanent way of railways.
1565. John Bailey Denton, Stevenage—Improved hoes and spuds.
1567. George North, Lewisham-road—Improved apparatus to be attached to garments for protecting watches, purses, and other articles from being stolen from the person.
1568. William Warcup, Lyndhurst-villa, Coronation-road, Bristol—Improvements in the construction of springs for carriages and similar purposes.
1580. William Beckett Johnson—Improvements in steam engines.
1587. William Ball, Rothwell Kettering—Improvements in drills.
1592. Jean Barthélemy Gillet, Agde (Hérault), France—Improvements in capstans, winches, and windlasses.
1595. Francis Whitehead and William Whitehead, Crayford—Improvements in safety lamps.
1606. Nicholas Callan, Maynooth College—Means by which iron of every kind may be protected against the action of the weather and of various corroding substances, so that iron thus protected will answer for roofing for cisterns, baths, gutters, window frames, telegraphic wires, for marine and various other purposes, and by which brass and copper may be similarly protected.
1608. Richard Archibald Brooman, 166, Fleet-street—Improvement in treating raw silk fabrics while being dressed and dyed. (A communication.)
1609. James Sedgwick, Lewisham—Improvements in ship-building.
1639. William Church, and Samuel Aspinwall Goddard, Birmingham—Improvements in ordnance.
1657. Samuel Frankham, Greenland-place, Judd-street—Improvement in the construction of furnaces.
1680. Edwyn John Jeffery Dixon, Bangor—Improvements in apparatus for teaching reading and arithmetic.
1741. William White, York-villa, Kensington-park, Bayswater—Improvement in deodorising the contents of cesspools, privies, and also like matters in other places.
1808. Thomas Webster Rammell, Trafalgar-square—Improvements in stoves and fire-places.
1835. William Henry Smith, M.D., Philadelphia, Henry Bessemer, Baxter-house, St. Pancras, and Robert Longsdon, Hornsey-lane—Improvements in the manufacture and treatment of slag and vitreous substances, and the combination of other substances therewith.
1894. Pierre Amable de Saint Simon Sicard, Paris—Improvements in apparatus for raising and destroying submerged vessels, rocks, and other bodies, and also in apparatus to facilitate the examination of submerged bodies.
2181. William White, York-villa, Kensington-park, Bayswater—Improvements in the manufacture of manures.
2183. Ancel Alexander Routledge, Neath—Improvements in the manufacture of detonating railway signals.
2295. Jabez Morgan, Kidderminster—Improvements in machinery or apparatus for cutting metals.
2310. Thomas Frederick Tyerman, Weymouth-street, Portland-place—Improvements in preparing hoop iron and such like metal surfaces used for bondings in buildings and structures.
2329. Henry Walmsley and John Day, Failsworth, near Manchester—Improvements in looms.
2335. James Atherton and John Kinlock, Preston—Improvements in machinery or apparatus for preparing and sizeing or dressing yarns or threads.
2344. Frederic Rainford Ensor, Nottingham—Improvements in bobbin net or twist lace machinery.
2358. John Bird, Chance's Fire-brick Works, near Dudley—Improvements in reverberatory furnaces.
2359. William Beardmore, Stowage, Deptford—Improvement in the bearings of the axles of railway carriages and locomotive engines.
2367. Allan McDonald and Alexander McIntosh, Alexandria, Dumbarton—Improvements in machinery for stretching and smoothing cloth or woven fabrics preparatory to or in the course of being printed.
2375. David Ferrier, Edinburgh—Improvements in facilitating a reference to books.
2380. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvements in machinery for turning prismatic forms.
2421. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of manufacturing soluble silicates.
2435. Joseph Wilson, Hopton, Yorkshire—Improvements in the manufacture of printed warp fabrics.
2443. George Tomlinson Bousfield, 8, Sussex-place, Loughborough-road, Brixton—Improvements in the manufacture of wrought-iron carriage and other wheels and pullies.

Sealed January 16th, 1855.

1583. Samuel Mitchell, Dewsbury—Improvements in the manufacture of cards for carding wool, cotton, silk, and other fibrous materials.
1586. James Longley, Hunslet-road, Leeds—Machine for turning and finishing tubs, pails, casks, and other wooden vessels of an elliptic, oval, or other eccentric form.
1596. John Hackett, Derby—Covering india-rubber thread, whether vulcanized or otherwise, with sewing silk and with other articles.
1614. Thomas Firth, Huddersfield, and John Wilson, Mirfield—Improvements in finishing woollen, worsted, silk, and other woven fabrics, and in the apparatus employed therein.
1616. William Septimus Losh, Wreay Syke, near Carlisle—Improvements in bleaching.
1634. William Stephens Garland and Josiah Glasson, Soho Foundry—Means of consuming smoke in furnaces.
1658. Barton H. Jenks, Bridesburg, Pennsylvania, U.S.—Improving the art of weaving, being an improvement in looms for weaving fancy fabrics.
1666. Francis Morton, Liverpool—Improvements applicable to girders or rafters to be used in the construction of roofs, bridges, buildings, and other erections.
1670. Robert John Keen, Liverpool—Improvements in the mariner's compass.
1692. Christopher Ridout Read, Moorgate-street—Improvements in slide valves of steam engines.
1698. James Griffiths, Wickham Market—Improved lever bit for horses.
1752. Edward Monson, Birmingham—Improved machinery for manufacturing, cleaning, and polishing daguerreotype plates.
1824. Joseph Barrows, Handsworth—Improved instrument to be used in cutting loaves of bread and other articles of food.
2256. John Maddox, Thomas-street, Brick-lane, Edward Gardner, Buxton-street, and George Dyer Green, Weaver-street—Improvements in weaving fringes.
2350. Louis Napoleon Langlois, Paris—Improvements in the construction of steam boats.
2356. Edward Simons, Birmingham—Improved candlestick.
2372. Charles Dalrymple Cranstoun, Elgin—Improvements in coupling and uncoupling railway carriages and rolling stock.
2382. Henry William Harman, Dock-yard, Northfleet—Improvements in windlasses, capstans, crabs, cranes, and other machines or apparatus for raising, lowering, or moving heavy bodies.
2406. Adolphe Pécoul, Marseilles—Improved system of marine log, to be called "sounding log."
2432. William Hann, Hetton Fence Houses, Durham—Improvements in propelling vessels.
2446. Henry Robert Ramsbotham, and William Brown, Bradford—Improvements in combing wool, cotton, tow, certain descriptions of hair, and other fibrous substances.
2474. George Collier, Halifax—Improvements in the manufacture of mohair plush.